Marine Institute
Foras na Mara

Newport Research Facility

ANNUAL REPORT

No. 52

Report for the year ended 31st December 2007

This report follows in sequence from the Annual Reports of the Salmon Research Agency of Ireland Inc. and The Salmon Research Trust of Ireland Inc.

Office and Laboratory:

Farran Laboratory, Newport, Co. Mayo.

Telephone: (098) 42300
FAX: (098) 42340
(098) 41112 (Smolt Unit)
E-mail: newport.reception@marine.ie

SUMMARY

1. The Salmon Research Agency of Ireland merged with the Marine Institute on the 1st July 1999 into Aquaculture & Catchment Management Services. This report provides a continuation of the data records for the Burrishoole facilities.

2. The total rainfall recorded in Furnace in 2007 was 1576.8 mm. Months of relatively high rainfall in 2007 were January, February, May, June, July and December with low rainfall in April, August and October.

3. The total release of microtagged salmon smolts of Burrishoole reared origin into L. Furnace amounted to 21,014. Smolts were released as two core and one SLICE treated groups, ranging in mean weight from 58g to 83g. A further 5,231 smolts were microtagged, freeze branded, and released as two 'experimental' groups.

4. In 2007, the Irish Government introduced a cessation of drift netting for salmon at sea.

5. A total of 983 (revised to 1049) wild grilse were recorded moving upstream through the permanent traps during the season. The number of spring fish recorded was 12. The total return of wild grilse, including the Furnace rod catch (2), was 985 (revised to1051).

6. Returning adults were checked for net mark damage; 0.3% (n=682) of wild grilse and 0.1% (n=1688) of reared grilse had net marks recorded. This is a large reduction on previous years.

7. The maximum spawning escapement was 895 (revised to 958) wild and 80 reared fish

8. A total of 6685 wild salmon smolts were recorded in the downstream trap in 2007. The wild return of 2006 smolts as wild grilse in 2007 was 12.8% (revised to 13.6%). The return to freshwater of the Burrishoole reared grilse recorded was 4.8%, increased from 1.9% in 2006. The ova to smolt survival at 0.68 – 0.76%

9. A total of 94 wild sea trout and a further 93 non-silvered trout migrated upstream through the traps in 2007. Of the sea trout, 7 were adults and 87 (93%) were finnock. The 2007 sea trout smolt run amounted to 593 smolts.

10. The percentage of smolts returning as finnock in the same year has historically ranged from 11.4% to 32.4%. In 1989 it collapsed to a minimum of 1.5%. There has been a saw-tooth pattern of finnock return in the 1990's between 4 & 10%, rising to 16.7% in 1999 – the highest return rate since 1986. Finnock return in 2007 was at 14.7%.

11. Silver eel trapping continued with the total run amounting to 2546 with the run mainly in September and November due to low water levels in October.

12. A total of 195 salmon were caught in the Fishery in 2007. The catch consisted of 26 wild fish and 169 reared salmon. Of the 26 wild fish caught, 24 were returned alive to the water and two were killed. There was a minimum of 58 sea trout caught on L. Furnace and returned alive.

13. Invertebrate surveys were carried out in 2006 and 2007 on the Owengarve and Burrishoole catchments.

1. INTRODUCTION

The Salmon Research Agency merged with the national Marine Institute on the 1st July 1999. The staff of the Agency were absorbed into the Aquaculture and Catchment Services Group of the Institute and the research facilities at Furnace have undergone a programme of upgrading and improvement. The core monitoring work of the Agency will continue but its unique experimental facilities, both in relation to aquaculture and wild fisheries, will be fully utilised within the context of the Institutes published Research, Technology, Development and Innovation Strategy. The merger has resulted in an increased national role for the work of the Agency and a consolidation of the trap and laboratory facilities at Newport.

This report represents a continuation of the Annual Reports published by the Salmon Research Agency of Ireland. The data presented creates a unique record of fish rearing and wild fish census data for the past 38 years. This data is an essential component in the local, regional and national management of salmon, sea trout and eel and is becoming ever more valuable in the light of increasing pressures on natural stocks, such as exploitation, habitat degradation and global climate change scenarios. The fish monitoring facilities in Newport, along with the reared and ranched salmon stocks held in Burrishoole, are also essential for the evaluation of novel enhancement techniques, alternative stocks and ranching and evaluation of interactions between farmed, ranched and wild strains.

Photo: M. O'Grady

2 ENVIRONMENTAL DATA

2.1 Mill Race Data

Daily meteorological data were collected during 2007 at the manual Met Station in Furnace. The monthly rainfall figures for 2004, 2005, 2006 and 2007 are given in Table 2.1, along with the annual totals for the years 1977 to 2007. Months of relatively high rainfall in 2007 were January, February, May, June, July and December. Low rainfall was recorded in April, August and October. The total rainfall was 1576.8 mm in 2007.

Table 2.1. Monthly rainfall totals (mm) for the Furnace Station in 2004, 2005, 2006 and 2007 and the annual totals for 1977 to 2007.

Month	2004	2005	2006	2007	Year	Total
January	186.8	286.2	95.9	202.9	1977	1579.7
February	71.9	104.5	99.7	116.6	1978	1592.2
March	123.8	76.8	131.0	122.0	1979	1653.3
April	117.1	124.8	104.5	55.7	1980	1792.1
May	82.0	140.0	135.6	129.7	1981	1646.8
June	111.3	97.1	37.8	121.1	1982	1609.6
July	104.0	44.0	60.9	191.7	1983	1495.9
August	102.6	132.2	69.0	87.4	1984	1556.6
September	198.6	123.6	198.8	120.4	1985	1584.1
October	192.8	133.9	178.0	92.0	1986	1886.9
November	114.2	182.3	182.3	131.8	1987	1373.6
December	236.2	162.8	257.3	205.5	1988	1715.2
					1989	1583.9
					1990	1805.9
					1991	1549.6
					1992	1771.1
					1993	1473.4
					1994	1757.1
					1995	1382.5
					1996	1286.6
					1997	1351.6
					1998	1830.9
					1999	1949.1
					2000	1833.2
					2001	1298.7
					2002	1715.9
					2003	1353.2
					2004	1641.3
					2005	1608.2
					2006	1550.7
					2007	1576.8

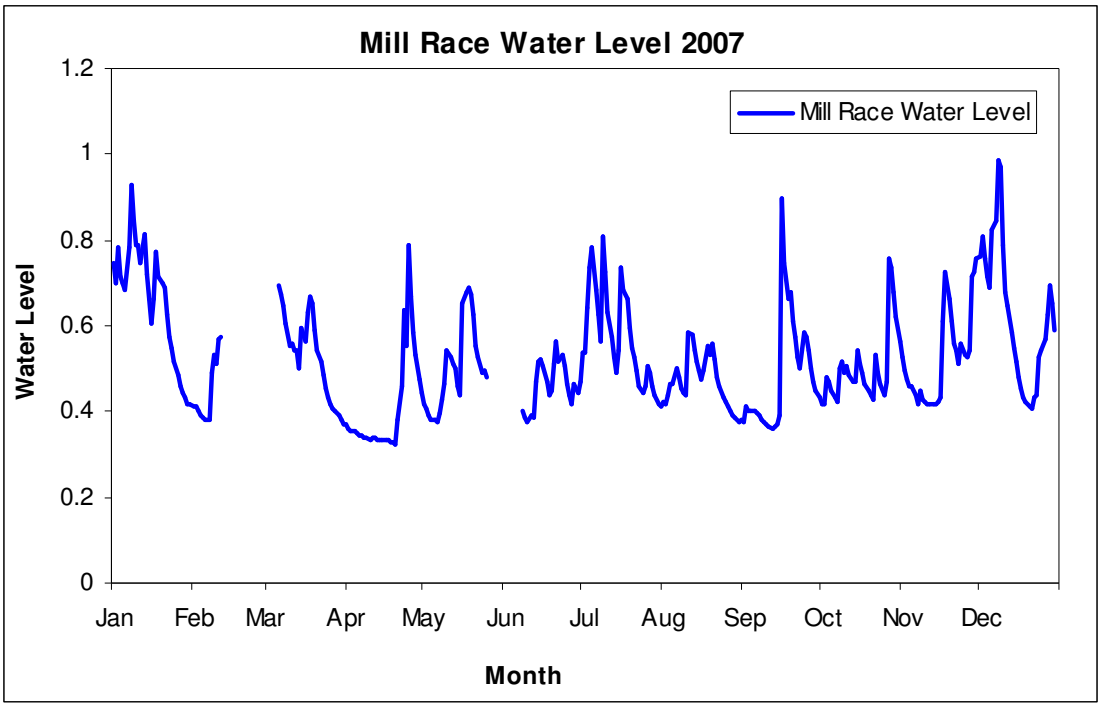


Fig. 2.1. Water levels recorded at mid-night for the Mill Race using an OTT Orphimedes automatic water level recorder.

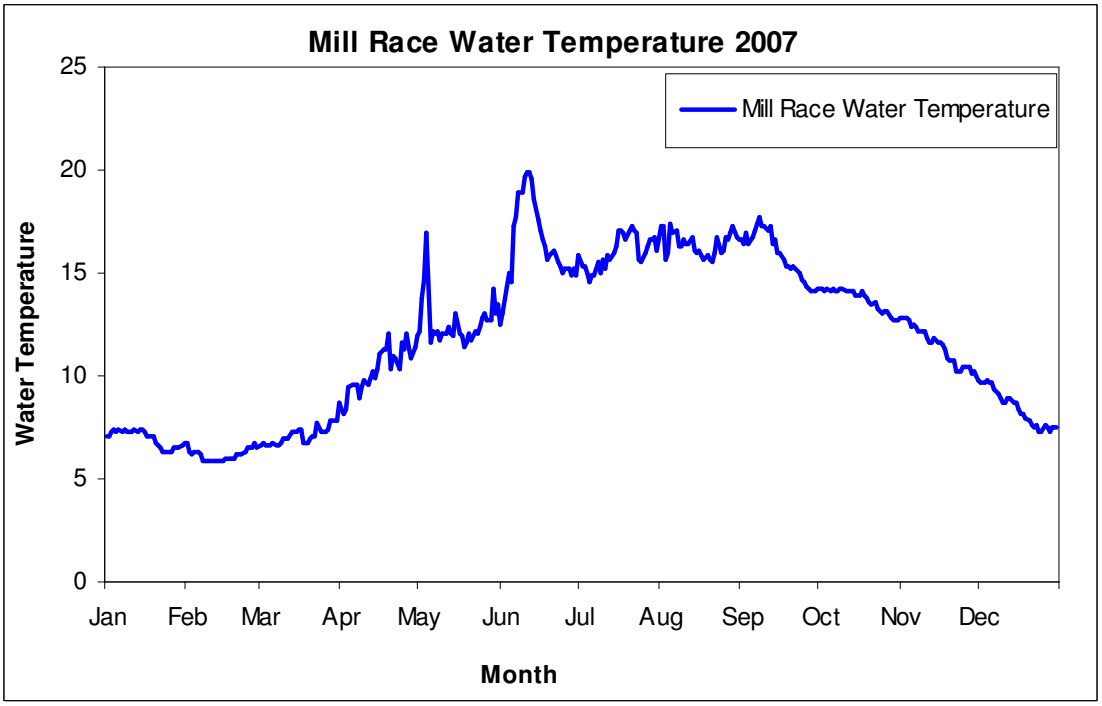


Fig. 2.2. Water temperatures recorded by TidbiT data logger at mid-night for the Mill Race.

Water Level: Difficulties were experienced in 2003 with the automatic water level chart recorder. An OTT Orphimedes automatic water level recorder was installed in late January 2004. Water levels are recorded every 15 minutes and are presented in Figure 2.1 recorded at 23.45 hrs. This approximates to the previous mid-night readings from the chart recorder.

Water Temperature: In 2004, a TidbiT temperature logger was installed along with the chart recorder and this records water temperature every 30 minutes. The temperature logger data is presented in Figure 2.2, recorded at less than 30 minutes before midnight.

Water temperatures (recorded at midnight) fell to a minimum of 5.9^{o}C on the 1st March. There was a steady increase in temperature from early March through to early May. Two peaks occurred in May & June, with maxima of 16.9^{o}C on the 4th May and 19.8^{o}C on the 12th June. Temperature remained at 16-17 ^{o}C from mid-June to mid-September before dropping steadily for the rest of the year to a minimum of 7.2 ^{o}C in late December. Temperature in December was over two degrees warmer than that in 2003 and similar to 2004, 2005 and 2006.

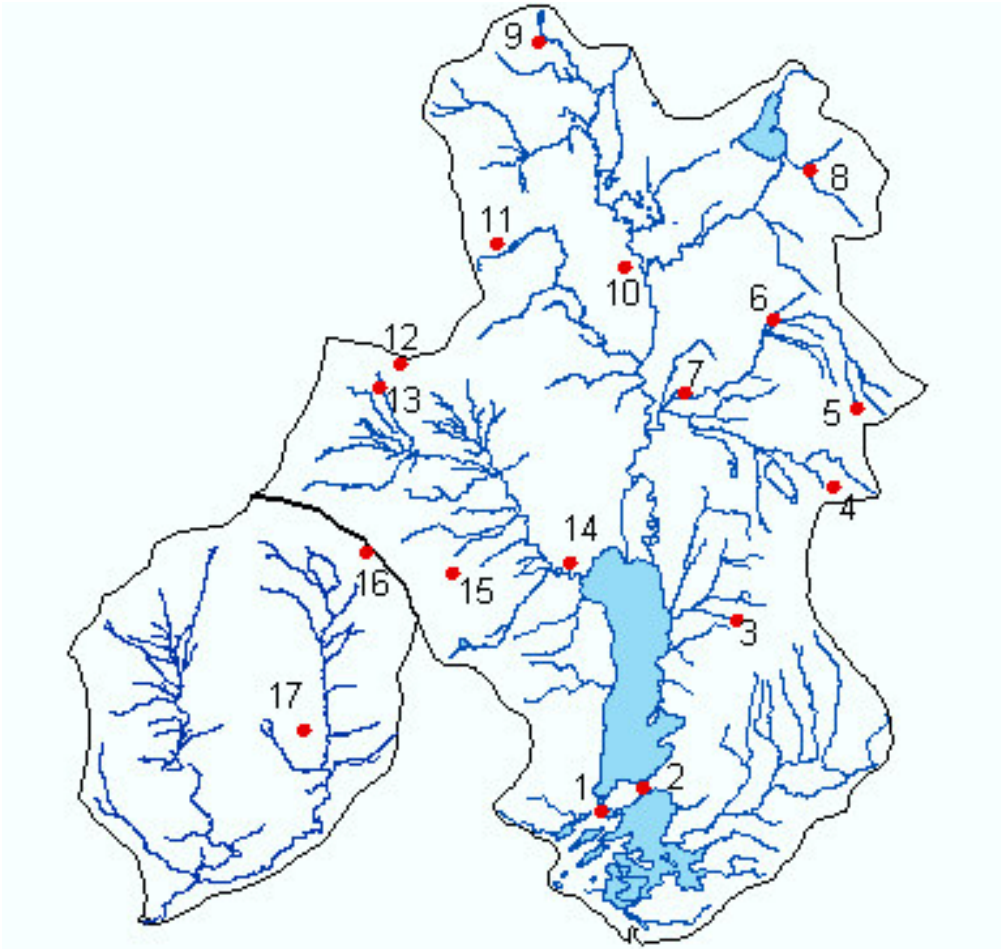
2.2 Catchment Programme

In recent years, the combined effect of extreme weather events with impacts of land use, have had a significant effect on the erosion rates recorded in many upland areas. Since 1995 the Marine Institute has operated a series of automatic monitoring stations to monitor these impacts, and to attempt to quantify the transport of suspended sediments in the Burrishoole catchment. These automatic stations, funded under EU LIFE and National programmes, include a lake station (AWQMS – installed under EU LIFE 93), which has various meteorological instruments included with a suite of underwater temperature and water chemistry sensors, and three river stations, (ARMS – installed under EU LIFE 98), which are equipped with sensors for measuring water temperature, water level, pH, conductivity, dissolved oxygen, and turbidity. The automatic monitoring stations are also equipped with a telemetry system for relaying high-resolution data back to the laboratory.

In addition the Institute has also deployed additional core-funded instrumentation in the catchment including temperature loggers, water level recorders and seventeen data-logging rain gauges in the Burrishoole and Owengarve catchments (Figure 2.3) and two in the Owenduff catchment, which will assist in building up a detailed profile of precipitation in a mountainous catchment.

Also deployed within the catchment are a series of OTT Orphimedes water level recorders which measure water level at fifteen-minute intervals. These data can be used to calculate water volumes on an hourly or daily basis. An important feature of the monitoring network is the ability to simultaneously collect data from river, lake, and climatic instruments. The continuing integration of this data with ongoing fish population surveys is an important component of the research programme.

It is proposed to include the Burrishoole catchment and weather datasets in a comprehensive project funded within the SSTI Climate Change programme (RESCALE). This project will commence in early 2008 and will report at the end of 2009.



1.	Salmon Leap	10.	Altahoney	19.	Glenadeegan
2.	Mill Race	11.	Maumaratta		
3.	Buckogh	12.	Glenamong 1		
4.	Lodge	13.	Glenamong 2		
5.	Srahrevagh 1	14.	Glenamong 3		
6.	Srahrevagh 2	15.	Glenamong 4		
7.	Srahrevagh 3	16.	Ridge		
8.	Gaulaun	17.	Glendahurk		
9.	Namaroon	18.	Tarsaghaun		

Figure 2.3. Rain gauge sites in the Burrishoole and Owengarve systems. 18 & 19 not on map.

3 SALMONID REARING

3.1 Salmon Stocks 2006

3.1.1 Ranching

The total release of microtagged smolts of ranched Burrishoole grilse origin into Lough Furnace was 21,014. Two core and one 'SLICE' group, comprising 5 tag codes, were released on 24th and 27th April 2007. Mean weights ranged from 58 to 83 grams.

Ongoing experimental programmes included the use of 'SLICE', to protect smolts against lice infestation during the first weeks at sea and thereby investigate if lice infestations are a significant factor in early marine mortality of Irish salmon smolts.

Two groups of microtagged and vaccinated (Norvac Compact 4) pre-smolts of ranched Burrishoole grilse origin were released into the River Liffey on 28th March 2007. A total 20,275 pre-smolts, averaging 59gms and comprising 5 tag codes, were released upstream and downstream of the ESB dam, with a view to monitoring marine survival.

In addition to the Burrishoole ranch groups, 5,231 salmon smolts, branded H, were released on 27th April 2007 (2 tag codes). This group was produced in December 2005 using Burrishoole wild parents and forms part of an ongoing study to compare the relative fitness of Burrishoole ranch and wild populations.

Tag code details are shown in Section 5.4.

3.2 Salmon Stocks 2007

Burrishoole ranch and commercial Fanad (2SW) stocks were hatched in 2007. Growth and survival was exceptionally good in the ranch stock with a survival of 94% to July. Eyed salmon ova (285,000) from Fanad were supplied in January 07 for contract rearing. Losses were exceptionally high in the Fanad stock, which sustained particularly high losses in April and May due to a problem with yolk sac absorption. Survival to July was only 61% but thereafter mortalities were minimal. Grading was carried out in July and August 2007.

Formalin treatments to control parasites were required more frequently in 2007. Unusually, treatments were required in November and December, possibly a consequence of elevated seasonal water temperatures.

An estimated 150,000 Fanad parr were transferred off site in August (85,500) and October (64,500), averaging 8.2g and 37.8g respectively. Stocks remaining in December 2007 comprised 45,157 Burrishoole ranch and 6,875 Fanad (small grade) salmon.

3.3 Salmon Stocks 2008 (Grilse ova laid down in 2007)

Salmon broodstock were held in circular fibreglass tanks from mid September and transferred to the broodstock holding pond on 22nd October 07. In total, 425 adults (215 females, 210 males) were held during the stripping period. Only two hens were ripe on December 4th and were retained for commencement of stripping on 13th December. Unusually, 5 of the 17 males randomly netted on 13th December were producing little or no milt. The majority of

microtags were read within a day of stripping and 7 female and 20 male broodstock were identified as 'branded experimental' salmon. Fertilised ova from these fish were excluded from the programme.

An estimated 395,000 green ova were produced by 117 Burrishoole hens. The average fecundity value was 3,379 per female. At the end of the stripping period on January 9th, 59 females remained unready to strip (i.e. 27 % of females held). Twelve fish were retained for a further two weeks to assess development and two fish remained unready to strip. A proportion of each family was retained in the hatchery from each of the 5 stripping dates, totaling 77,800 eyed ova (117 females). Later, unfed fry from the first stripping were culled (as the group was too small) and therefore 66,000 eyed ova were retained from 109 hens for the ranching programme.

In 2007 there were a number of reports of wild Atlantic salmon returning to natal rivers to spawn with swollen, inflamed and bleeding vents associated with Anisakis simplex larvae. A proportion of Burrishoole ranch salmon were affected, though the presence of anasakis had no adverse effect on fertility / ova production. In collaboration with Dr. Tom Murphy, five grilse with haemorrhagic vents were randomly selected in December, killed by a blow to the head and examined for the presence of parasitic larvae. A further six adults were sacrificed and examined in January 2008 at the end of stripping period. The number of nematodes visible in the body cavity or loosely attached to the mesentery of the intestine and serosal surface of the liver was noted. Tissue samples were taken for histology and a number of larvae from ten of these 11 adults were isolated and fixed in 70% ethanol for species identification.

Broodstock condition was good throughout the holding period, although formalin treatments were necessary during October and November to control skin parasites. Fish were tested by the Marine Institute Fish Health Unit in December and subsequently salmon ova were certified disease free. Ova quality and survival was good.

3.4 Rainbow Trout 2007

An estimated 6,830 0+ rainbow trout (Seven Springs NI) were stocked into Ballinlough Fishery, from September to November 2007. An estimated 1830 trout were retained in December 2007 for stocking in 2008.

3.5 Sea lice vaccine research programme

In 2005, the Faculty of Veterinary Medicine UCD was awarded funding for the project ' Novel Vaccines for the Control of Sea Lice on Salmonids' through the NDP Marine RTDI Fund for collaborative research with the Aquaculture Section, ACMS. The objectives of this project are to identify and isolate novel sea lice vaccine candidates and to undertake studies that will identify parameters associated with immunological resistance to infection in vaccinated fish. The research programme consists of a number of work packages: identification of vaccine candidates, fish vaccination, sealice culture, infectivity trials and immunological studies. The fish production and vaccination components of this research programme are carried out using freshwater rearing facilities in Furnace.

In January 2007, 1260 vaccinated (3 antigens, 2 adjuvants) and branded S½ salmon smolts, comprising 7 groups, were transferred to the ***Shellfish Research Laboratory*** in Carna for infectivity trials. Also, 300 S½ smolts comprising 2 groups (1 antigen, 1 control) were

transferred to the Institute's experimental saltwater facilities in Galway. In March 2007, 800 S1 pre-smolts were vaccinated (2 antigens, 2 adjuvants) and branded to produce 8 groups and transferred to Carna in April. A further 700 vaccinated parr (Norvac Compact 4) were selected for S½ production in November 2007.

3.6 DIT Research programme

M.Sc. Studentship studies continued with Dublin Institute of Technology, to investigate biochemical changes in Atlantic salmon mucus proteins and their role during the smolting period. Mr. Paul Dunne continued proteomic research on Atlantic salmon as part of the Dublin Institute of Technology MPhil / PhD programme. Mucus samples were taken from ranch and wild salmon smolts in April and May 2007.

Technological Sector Research: Strand 1 funding was awarded to DIT in 2006 for a project entitled: CODES: A Computerised Diagnostic Test System for determination of Atlantic salmon (Salmo salar) key developmental and disease states. Ms G. Ramaswamy commenced research on this project in February 2007.

3.7 Molecular biology of the Atlantic salmon

This research, funded by HEA PRTLI (2003-2006), aims to characterise gene expression profiles during the key life stages of Atlantic salmon, particularly smoltification and maturation, using functional genomics tools. In partnership with the Molecular Biology Group, National University of Ireland Galway, ACMS provided materials and services in support of this programme. Three postgraduate students continue to work towards completion of theses and publications.

Publications 2007

Characterization of differentially expressed genes between resident and anadromous forms of brown trout (Salmo trutta L.) in intestine tissue. *Aquaculture*, *Volume 272, Supplement 1*, *2007*, *Pages S269-S270* O. Le Provost, S. Hubert, A.M. O'Keeffe, D. Cotter and M.T. Cairns.

Gene expression patterns in Atlantic salmon (Salmo salar): Gene expression in intestine tissue during smoltification. *Aquaculture*, *Volume 272, Supplement 1*, *2007*, *Page S270* S. Hubert, O. Le Provost, A.M. O'Keeffe, M. Voisin, D. Cotter and M.T. Cairns.

3.8 Salmon tracking

The impact of brominated flame retardents (BFRs), in this case hexabromocyclododecane (HBCD), on the behaviour of hatchery-reared smolts during their emigration from Lough Furnace and into the coastal zone, was studied in a collaborative programme with CEFAS. BFRs are used to confer safety properties on a wide range of products including textiles, furniture and electronics. BFRs are considered to be ubiquitous pollutants and can enter the aquatic environment from effluents derived from the manufacturing process or through leaching from landfills containing discarded BFR-treated materials.

A group of salmon smolts was exposed to an 'environmental' concentration of HBCD and 10 'treated' and 10 'control' (untreated) fish were tagged intraperitoneally with miniature coded acoustic transmitters (Model V9-6L-R04K, VEMCO, Canada). Twenty tagged salmon smolts were released on 27th April 2007 with other groups of ranch smolts and their subsequent

movements were monitored through Lough Furnace and into the marine environment using an array of strategically positioned acoustic receivers. In addition, the physiological status of treated and control groups was measured to determine the impact of HBCD exposure on hypoosmoregulatory capability and survival in saltwater. Receivers were downloaded at regular intervals and recovered after a period of six weeks.

Ten seatrout smolts were also tagged in the Salmon Leap downstream trap as fish migrated from Lough Feeagh on 25th April 2007. Additional receivers were deployed to assess the migratory behaviour of sea trout smolts.

3.9 Pond Replacement Programme 2007

The final phase of the pond replacement programme took place in the smolt unit between February and May 2007. Earlier, in 2005, eighteen 3.6 metre fibreglass tanks were replaced. In this phase, the remaining 32 tanks were replaced, associated outflow channels were re-lined, roadways were tarmacked and a new pipeline was installed to the broodstock pond. In addition, two 3.6m tanks in the Mill Race rearing area were replaced with 4 metre tanks.

4 SALMON CENSUS PROGRAMME

NOTE: In 2006 it became apparent that there was a problem related to the upstream count of reared and probably wild salmon. The number of reared salmon displaced downstream prior to the spawning season was higher than the number of fish released upstream and the majority of these displaced fish had not been previously floy tagged in the upstream trap. While it has been difficult to identify the source of the problem, it seems likely to have been isolated to the Mill Race and maybe due to a gap in the fish fence screens. This problem also seemed to occur in 2007.

In this, and subsequent reports, the actual trap counts are presented as a minimum upstream count and the most likely scenario for an actual upstream count is also presented. How this was determined is included as an Annex to this report. For 2007, we used the average kelt survival to determine a revised upstream run (Scenario 3 in Annex 2).

4.1 Wild Salmon and Grilse

A total of 983 wild grilse were recorded moving upstream through the permanent traps during the season (Table 4.1). The run commenced in May and was completed in January 2008. The main upstream grilse migration was recorded in the Salmon Leap trap with 795 grilse, compared to 188 grilse in the Mill Race trap.

The total number of spring fish recorded in the upstream traps was 12.

The retained rod catch of wild grilse on Lough Furnace was 2 fish. Therefore, the total wild grilse return, including the Furnace rod catch and the upstream count, was **985** (the revised total return of **1051** WG).

Table 4.1. Monthly wild grilse totals for the Salmon Leap and Mill Race traps.

	Mill Race	Salmon Leap	Total
May	0	3	3
June	14	62	76
July	64	489	553
August	36	136	172
September	59	87	146
October	0	10	10
November	5	8	13
December	8	0	8
January 08	2	0	2
Total	188	795	983

Note: the revised total count of **1049** WG.

Table 4.2. Monthly proportions (%) of wild grilse run 2003 –'07.

	2003	2004	2005	2006	2007
May	0.9	0.0	0.4	0.5	0.3
June	10.7	36.0	23.9	1.4	7.7
July	49.8	41.0	13.2	40.1	56.3
August	11.4	9.8	39.1	31.9	17.5
September	8.6	10.9	14.8	22.8	14.9
October	10.8	1.0	5.5	2.5	1.0
November	7.7	0.7	3.0	0.5	1.3
December	0.0	0.5	0.2	0.3	0.8
January 08	0.0	0.0	0.0	0.0	0.2

A late arrival of grilse to freshwater was reported in several Irish rivers during 2007. This was similar at Burrishoole with only 8% of the total run recorded by the end of June. Although the proportion of wild grilse migrating in June at Burrishoole increased from 1.4% in 2006 to 7.7% in 2007, the low 2006 figure was partially as a result of very low water conditions at Burrishoole.

In June 2007, the proportion returning was lower than observed in recent years with similar water levels, e.g. 36% in 2004 and 23.9% in 2005.

Although fish can remain in Lough Furnace prior to migration upstream the low rod catch on Furnace during June, (1 wild grilse) would suggest that few fish were present in the lake.

Table 4.3. Wild salmon and grilse totals in upstream traps 1970-2007.

Year	Total Salmon	Total Grilse
1970-74	14	1145
1975-79	36	703
1980-84	35	449
1985-89	22	492
1990-94	16	421
1995	15	582
1996	18	409
1997	6	538
1998	4	516
1999	16	502
2000	6	568
2001	6	368
2002	2	648
2003	18	544
2004	28	580
2005	9	532
2006	31	364 (revised to **530**)
2007	12	983 (revised to **1049**)

Note: the revised total count of **1049** WG.

4.2 Net marked fish in upstream traps

In 2007, the Irish Government introduced a cessation on drift netting in Irish coastal waters. As a consequence there has been a major reduction in the percentage occurrence of net marks in returning adult wild and reared salmon examined in the trapping facilities. A total of four fish, two wild and 2 reared were recorded with net marks (Table 4.4). The net marks on the wild fish were recorded in August, this was a 0.3% occurrence compared to 29.1% for August 2006. Similarly the occurrence of net marks on reared fish which were recorded in September decreased from 51.3% in September 2006 to 0.2% in 2007.

Table 4.4. Percentage Occurrence of Net Marks on Wild and Reared Grilse

	Wild Grilse	Reared Grilse
May	0.0	0.0
June	0.0	0.0
July	0.0	0.0
August	0.3	0.0
September	0.0	0.2
October	0.0	0.0
November	0.0	0.0
December	0.0	0.0
	n = 682	n = 1688

4.3 Wild Spawning Stock

The spawning stock represents the number of fish available for spawning. It is calculated by subtracting rod caught fish and downstream-displaced fish as well as losses due to poaching, disease and predation, which have been estimated at 5% for wild fish and 10% for reared fish.

It was again noted in 2007 that the number of reared fish displaced downstream prior to the spawning season (307) was greater than the number of reared fish released upstream (97). This was similar to 2006 and, as in 2006; the majority of displaced fish were recorded in the same year. In 2007, of the total of 259 reared fish recorded in the downstream traps between September 07 and May 08, 84.6% (219) were recorded prior to the end of December 07 and 15.4% (40) were recorded in '08. This would suggest that a minimum of 40 ranched fish were available as potential spawning stock in 2007. However, it should also be noted that in 2007 reared fish in the commercial hatchery ripened later than normal and on the first stripping date 13th of December only 12 fish were ripe. It was noted that up to 17th of January '08 all females recorded in the downstream traps were still ripe, therefore not all of the 40 ranched fish recorded in '08 contributed to the overall spawning stock.

In relation to the wild spawning stock a total of 492 fish were recorded as kelts from an estimated spawning escapement of 895 fish. This is equivalent to a 55% survival to kelt. As this is within the recent range of wild kelt survival prior to 2006 it would suggest that the number of wild fish migrating upstream undetected was low.

The overall conclusion is that although both wild and reared fish migrated upstream undetected in 2007 the majority of reared fish were displaced downstream prior to spawning resulting in a low reared fish component in the spawning stock. It is likely that the wild grilse count is a minimum figure and this will have to be taken into account for all calculations based on the 2007 spawning escapement. The revised figure for total spawning escapement is 1038, giving an upstream wild stock of 958, or wild spawning stock of 948 grilse plus 10 MSW and 80 reared grilse (table 4.5 & 4.6).

Table 4.5. Spawning escapement 1970 - 2007

	Maximum spawning escapement	Wild fish component	Reared component
1970-74	1126	986	140
1975-79	725	683	42
1980-84	474	430	44
1985-89	662	428	232
1990-94	603	348	254
1995	464	376	102
1996	594	355	239
1997	494	466	28
1998	498	456	42
1999	547	485	62
2000	567	527	40
2001	370	349	21
2002	570	562	8
2003	517	506	11
2004	554	528	26
2005	503	472	31
2006	394 (552)	362 (520)	32*
2007	975 (1038)	895 (958)	80**

* estimated from 16 kelts
** estimated from 40 kelts
Note: revised wild figure in brackets

Table 4.6. Spawning stock of salmon and grilse (see below for revised table)

	Wild grilse(1SW) & previously spawned grilse	Wild Salmon (2SW)	Ranched fish released upstream
Counted in trap	983	12	97
Rod Feeagh*	--	--	--
Culled	3	--	0
Broodstock	0	--	0
Estimated morts.	49	1	0
Displacement	46	1	307**
Spawning stock	**885**	**10**	**80**

* No angling on L. Feeagh during 2007. ** displaced by the end of December

Table 4.6 Revised. Revised table of spawning stock of salmon and grilse

	Wild grilse(1SW) & previously spawned grilse	Wild Salmon (2SW)	Ranched fish released upstream
Counted in trap	1049	12	387
Rod Feeagh*	--	--	--
Culled	3	--	0
Broodstock	0	--	0
Estimated morts.	52	1	0
Displacement	46	1	307**
Spawning stock	**948**	**10**	**80**

* No angling on L. Feeagh during 2007. ** displaced by the end of December

4.4 Survival from Ova to Grilse

The relevant brood year for the 2007 grilse was 2003 with ova hatch in 2004 and smolt migration in 2006 (Table 4.7). As in previous years, it has been assumed for the purpose of estimating survival that ranched grilse spawned naturally. Specific data are not available on differential survival rates of wild and ranched stocks spawned in the wild. All relevant calculations are based on parameters set out in the Ann. Rep. No. 19, 1974.

Table 4.7. Survival from ova to grilse

Spawning escapement in 2003	517
No. of females	259 - 284
Ova deposition	1,036,000 – 1,168,660
No. of smolts in traps 2006	7918
No. of smolts released	7701
Survival ova to smolt	0.76 – 0.68
No. returning grilse 2007	985
Survival smolt to grilse	12.8%
Survival to grilse per grilse female	***3.5 – 3.8***
Revised figures	
No. returning grilse 2007	1051
Survival smolt to grilse	13.6%
Survival to grilse per grilse female	***3.7 – 4.1***

4.5 Ova to Smolt Survival

The survival of ova to smolt ranged from 0.68 to 0.76.

The survival of smolt to grilse increased from 5.2% (revised to 7.6%) in 2006 to 12.8% (revised to 13.6%) in 2007. This increase in survival to freshwater is partly a consequence of the cessation of drift netting at sea.

The survival to grilse per grilse female was 3.5 – 3.8 (revised to 3.7-4.1).

Table 4.8. Comparative data for the five-year averages from 1970 - 1989 and the values for the individual brood years from 1990 onwards.

Brood year-class	% survival rates ova to smolt	survival rates to grilse per grilse female spawner
1970-74	0.48 - 0.62	1.4 - 1.7
1975-79	0.63 - 0.73	1.5 - 1.7
1980-84	0.61 - 0.69	1.7 - 1.9
1985-89	0.44 - 0.45	1.4 - 1.5
1990	0.47 - 0.54	1.8 - 2.0
1991	0.47 - 0.53	1.8 - 2.0
1992	0.48 - 0.54	1.3 - 1.5
1993	0.39 - 0.45	1.5 - 1.6
1994	0.36 - 0.41	1.3 - 1.4
1995	0.83 - 0.93	1.9 - 2.1
1996	0.53 - 0.61	1.8 - 1.9
1997	0.52 - 0.59	1.4 - 1.5
1998	0.58 - 0.60	2.4 - 2.6
1999	0.79 - 0.70	1.8 - 2.0
2000	0.56 - 0.64	1.9 - 2.1
2001	1.30 - 1.10	2.9 - 2.6
2002	0.56 - 0.64	1.2 - 1.3 (1.7-1.9)
2003	0.68 - 0.76	3.5 - 3.8 (3.7-4.1)

4.6 Wild Salmon Smolts

A total of 6685 wild salmon smolts were recorded in the downstream traps during 2007 which was a decrease from 7918 recorded in 2006.

Four main peaks of migration occurred during 2007 (Fig. 4.1). Water levels were very low during early April and the first two peaks in migration occurred on the 25th and 27th April following a period of rain which commenced on April 22nd with a total of 55mm of rain being recorded at the Furnace weather station over a five day period.

The second peak which occurred on the 2nd May occurred during a period of low rain fall. Smolts migrating during this period may have been displaced in the upper catchment during the high water levels in late April and required a period of time to reach the downstream trapping facilities. The final smolt peak, commenced on May 10th and followed a period of heavy rainfall in which 34 mm of rainfall had been recorded.

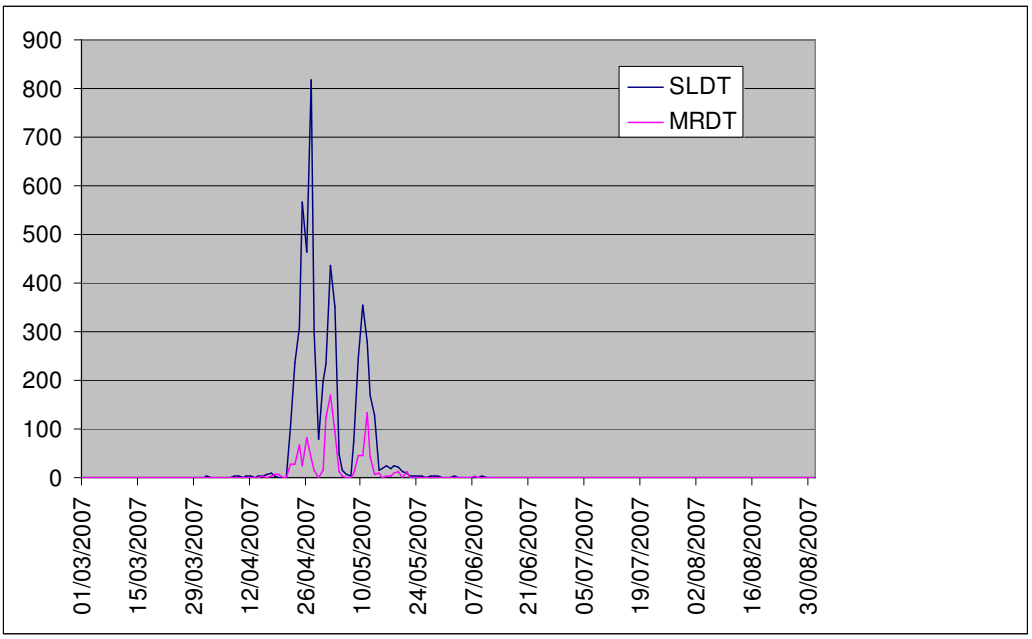


Figure 4.1. Timing of the 2007 wild salmon smolt run in the Salmon Leap & Mill Race traps.

Table 4.9. Numbers of wild salmon smolts counted in 2007.

Month	SLDT	MRDT	Total
March	3	1	4
April	3112	315	3427
May	2510	730	3240
June	7	4	11
July	1	1	2
August	1	0	1
Totals	5634	1051	6685

Table 4.10. Annual numbers of wild salmon smolt recorded in downstream traps.

1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
6331	9588	7197	5791	6466	8627	7248	9316	7261	7918	6685
5960*	8937*	7118*	5689*	6387*	8423*	7081*	9121*	7030*	7701*	6518*

*Number of smolts released to sea from traps when mortalities and samples were deducted.

4.7 Wild Salmon Kelts

The wild kelt run commenced in December 2006 and the peak of the run occurred during February 2007, with 100 kelts recorded.

It would be unwise to calculate a spawning stock to kelt survival for the 2006 broodyear, given the estimated nature of the upstream run in 2006.

Table 4.11. Numbers of wild salmon kelts counted in 2007.

	SLDT	MRDT	Total
Dec '06	11	2	13
January '07	17	11	28
February	95	5	100
March	71	1	72
April	42	19	61
May	0	0	0
Total	236	38	274

Table 4.12. Comparison of annual kelt runs:

	A	B	C	D	E
1975-79	75	18	14.0	30.0	8.1
1980-84	82	18	6.7	48.7	9.7
1985	94	26	3.0	56.0	7.7
1986	93	31	3.4	55.3	9.2
1987	68	15	10.8	22.6	9.7
1988	88	24	4.6	55.0	8.7
1989	96	11	3.7	27.0	6.6
1990	94	35	5.6	48.6	7.6
1991	98	39	3.4	82.3	9.7
1992	92	39	7.0	59.3	6.9
1993	83	5	3.2	52.7	7.4
1994	91	37	4.7	64.3	1.6
1995	74	28	18.3	59.9	2.3
1996	88.1	27	10.1	53.1	4.0
1997	93.7	33.5	6.3	58.9	*
1998	94.3	30.8	5.7	67.6	*
1999	90.6	38.5	4.5	76.0	*
2000	92.5	44.5	5.5	62.1	*
2001	97.0	38.5	2.8	72.5	*
2002	91.3	40.9	7.8	49.6	*
2003	95.5	37.0	3.5	42.3	*
2004	89.9	36.3	9.0	53.2	*
2005	83.3	35.5	15.3	57.6	*
2006	82.2	36.1	16.0	54.4	*
2007	95.0	37.3	4.1	**	*

* see section 4.7

A = % healthy kelts in kelt run

B = % males in kelt run

C = % lightly marked

D = % survival from wild spawning escapement

E = % recapture of previously spawned grilse in first year

5. REARED SALMON CENSUS PROGRAMME

5.1 Coastal Returns

Details of coastal returns of Burrishoole fish are available in the Marine Institute 'National Report for Ireland - The 2007 Salmon Season' report.

5.2 Return rate of Reared and Wild grilse

A total of 2553 microtags were retrieved from fish returning to the traps and rod fishery during 2007. They consisted of returns from 21 individual microtag groups released in 2005 and 2006.

The return rate of the core Burrishoole grilse increased from 1.9% in 2006 to 4.8% in 2007. The cessation of drift netting in 2007 is likely to have been a factor in the increase in survival to freshwater. A corresponding increase in survival to freshwater was also recorded for wild grilse which increased from 7.6% (revised figure) in 2006 and 13.6% (revised) in 2007.

5.3 Recapture of Reared 2SW Fish

The total number of microtagged 2 SW reared fish recorded in Burrishoole during 2007 was 50. They originated from nine release groups one of which was a release of precocious smolts in 2005.

5.4 Smolt Releases 2007

A total of 21,014 ranched smolts were released from Burrishoole during 2007. They consisted of 7,019 smolts for an on-going SLICE project and 14,037 smolts released as part of the core ranching programme. The core ranch smolts were released as two groups, a large grade core group as a control for the SLICE experimental group and a medium grade core group as a control for a wild experimental release group. Both core groups were released directly into Lough Furnace, the large grade group on April 24th and the medium grade on April 27th

In addition to the release of ranched smolts from Burrishoole in 2007, an experimental group of 20,275 Burrishoole smolts was transferred to the East coast and released into the river Liffey on the 28th March. For further information on the experimental groups (see section 3.1.1).

2007 Microtagged smolt releases

Group ID	Tag Code	Mean Wt (g)	Mean Length (cm)	Release date	No. Released
Experimental					
(H)	24796	66.1	17.6	27/4/07	2,049
	24796	51.8	16.3		3,182
	34790				
Core					
medium	24798	69.6	18.0	27/4/07	3,455
	34783	65.6	17.7		3,564
Slice					
large	34798	81.1	18.9	24/4/07	3,578
	34798	84.0	19.1		3,399
Core					
large	44764	77.5	18.7	24/4/07	3,508
	34792	79.3	18.8		3,510
R. Liffey					
	34796	62.3	17.3	28/3/07	6,044
	34793	54.8	16.6		4,086
	34794	60.7	17.2		6,056
	34795	52.9	16.5		4,089
	34797				

6 WILD SEA TROUT CENSUS PROGRAMME

The sea trout research and monitoring programmes were continued in 2007.

6.1 Upstream Movements: Timing and Numbers.

A total of 94 wild silvered sea trout and a further 93 non-silvered trout migrated upstream through the traps in 2007. Of the silvered trout, 7 were adults and 87 (93%) were finnock. The numbers are compared with other years in Table 6.1. Of the total run of migratory trout (187), 50% were non-silvered. For the purposes of this report, the non-silvered trout are not included with the sea trout. Table 6.1 shows clearly that the numbers of sea trout have not recovered in the Burrishoole system and have shown a ten-fold drop since the 1970s.

Table 6.1. Annual runs of sea trout recorded in the traps.

YEAR	MILL RACE	SALMON LEAP	TOTAL	Amended Total
1970-74	1365	762	2127	
1975-79	829	1775	2604	
1980-84	458	780	1238	1719 *
1985-89	386	590	978	
1990-94	134	72	206	
1995-99	86	91	177	
1985	479	976	1465	
1986	277	1110	1387	
1987	528	422	950	
1988	497	366	863	
1989	147	77	225	
1990	101	54	155	
1991	180	162	342	
1992	123	28	151	
1993	130	43	173	
1994	136	74	210	
1995	90	90	180	
1996	112	85	197	
1997	65	72	137	
1998	56	50	106	
1999	107	157	264	
2000	33	78	111	
2001	31	58	89	
2002	26	89	115	
2003	45	33	78	
2004	26	64	90	
2005	5	10	15	
2006	16	22	38	
2007	35	59	94	

* See Table 34, Ann. Rep. XXX (1985); p. 43.

The timing of the sea trout run in 2007, and in previous years, expressed in monthly percentages, is given in Table 6.2. The highest proportion of sea trout, both finnock and adults, moved upstream in June, July, August and September. The brown trout moved upstream throughout the period with peaks in July and November.

Table 6.2. Timing of the Burrishoole sea trout run and unsilvered trout run (in monthly percentages). (n = no. of trout).

Silvered Trout

	1970-'79	1980-'84	1985-'89	1990-'94	1995-'99	2000-'04 (483)	2005 (15)	2006 (38)	2007 (94)
May	-	0.2	0.5	0.1	3.1	2.0	6.7	0.0	0.0
June	13.1	24.6	9.4	8.4	8.6	16.7	26.7	0.0	16.1
July	54.4	44.9	62.2	55.0	42.4	37.5	0.0	10.5	53.8
August	15.8	10.3	18.4	16.5	19.3	26.4	60.0	26.3	15.1
September	7.6	14.8	3.7	8.5	9.8	5.7	6.7	44.7	10.8
October	6.4	3.5	4.1	7.9	12.2	10.2	0.0	15.8	3.2
November	2.4	1.5	1.5	2.9	4.3	1.5	0.0	2.6	1.1
December	0.3	0.2	0.2	0.7	0.7	0.0	0.0	0.0	0.0

Unsilvered Trout

	2005 (86)	2006 (61)	2007 (93)
April			2.2
May	4.7	16.4	5.4
June	10.5	9.8	19.4
July	4.7	16.4	25.8
August	43.0	11.5	4.3
September	12.8	13.1	6.5
October	9.3	27.9	7.5
November	10.5	3.3	20.4
December	4.7	1.6	8.6

6.2 Spawning Escapement

With the continuation of the catch and release bye-law into the 2007 fishing season and the closure of L. Feeagh to angling, no sea trout were reported killed by anglers on L. Feeagh in 2007. Using the upstream fish counts through the traps, the total maximum spawning escapement of migratory trout to the L. Feeagh catchment was 187, of which 94 were non-silvered sea trout.

Table 6.3. Annual spawning escapement of sea trout into freshwater.

	1970-'79	1980-'84	1985-'89	1990-'94	1995-'99	2000-'04	2005	2006	2007
Max. Escap	2090	1146	906	231	289	156	101	99	187
Revised		1622							

6.3 Downstream Movements, Sea Trout Smolts

The 2007 smolt run amounted to 593 smolts, of which all 593 were released to the wild (Table 6.4). Few smolts were recorded from January to March. The main migration occurred in April and May and was strongly regulated by water level (Fig. 6.1). The 2007 smolt run continued the trend of low numbers of smolts (Table 6.5).

Table 6.4. Monthly numbers of Burrishoole sea trout smolts recorded through the traps.

	Salmon Leap	Mill Race	Total	%
January	3	2	5	0.8
February	1	0	1	0.2
March	3	0	3	0.5
April	375	8	383	64.6
May	195	6	201	33.9
June	0	0	0	0.0
July	0	0	0	0.0
Total	577	16	593	
Number Released Downstream			593	

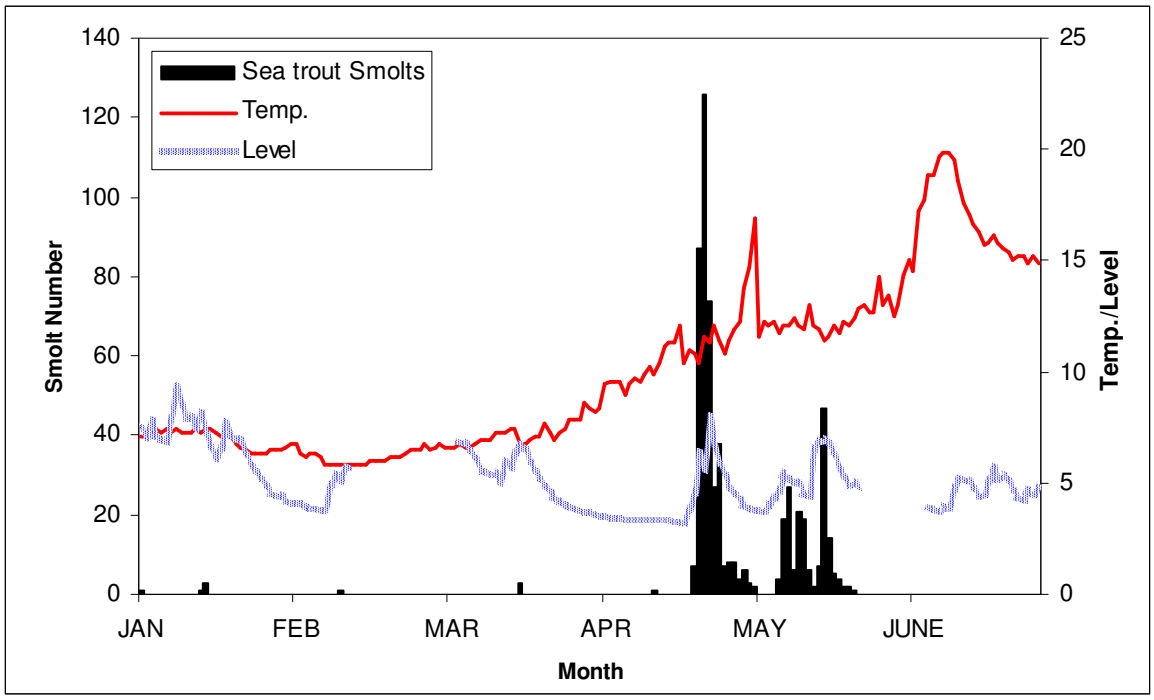


Fig. 6.1. Timing of the 2007 wild sea trout smolt migration with daily water level (m x 10) and temperature (^{0}C).

Table 6.5. Annual sea trout smolt numbers in Burrishoole for 1970 to 2007.

	1970-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005	2006	2007
Number	4176	4038	4119	1531	1361	816	777	626	593

A total of 198 wild smolts were measured in 2007. Length measurements were taken to facilitate an estimated age breakdown of the smolt run. The estimated statistics for the 2007 smolts were, mean length of 20.0 cm and a range from 14.3 to 26.0 cm and the length frequency is presented in Figure 6.2. This gave an estimated age of 84% 2 year old and 16% 3 year olds.

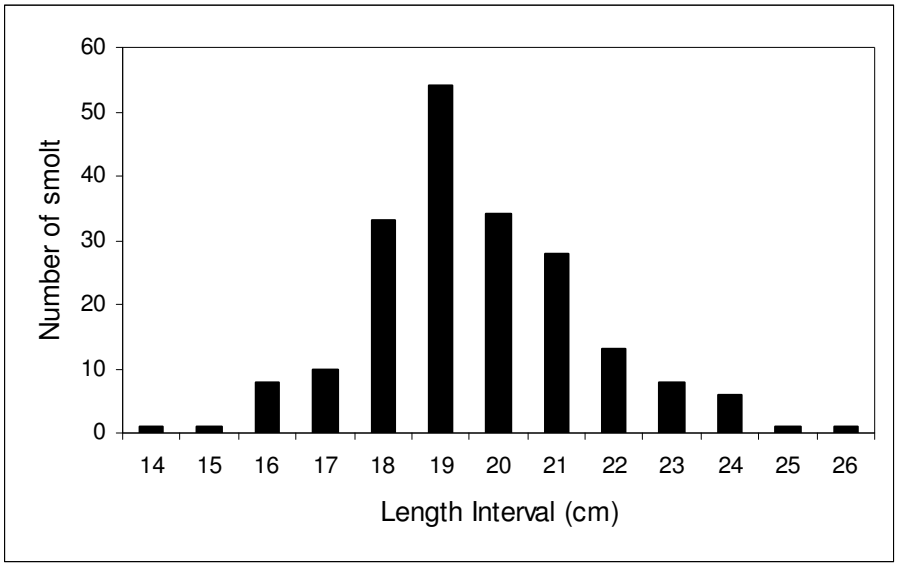


Fig. 6.2. Length distribution for smolts in the Burrishoole system, 2007 (n=198).

6.4 Autumn Migrating Smolts

These are juvenile trout (*Salmo trutta* L.) which generally move downstream through the traps from August to December. It is not clear whether these are true sea trout or part of the resident trout stock, should a difference exist. These runs of trout would appear to becoming more prolonged with substantial numbers of un-silvered 0+ and 1+ trout continuing to migrate downstream in the early months of the year.

A total of 741 trout entered the traps between July and December 2007 and up to May 2008 (Table 6.6). The percentage of 0+ trout that migrated over the period was 27.9% (Table 6.7).

Table 6.6. Numbers of migrating autumn juvenile trout in 2007, to the end of May 2008.

Month	0+		1+		Total	
	SL	MR	SL	MR	SL	MR
July	0	0	0	0	0	0
August	2	0	3	1	5	1
September	22	0	61	1	83	2
October	49	1	115	1	164	2
November	32	0	89	4	121	4
December	42	7	120	12	162	19
January 2008	27	1	39	4	66	5
February 2008	19	1	22	2	41	3
March 2008	1	1	28	8	29	9
April 2008	2	0	14	7	16	7
May 2008	0	0	1	2	1	2
Total	196	11	492	42	688	53
Overall Total	207		534		741	

Table 6.7. Percentage of 0+ juvenile trout in the trapped autumn migrating trout.

Year	%	Year	%
1982	50	1995	25.3
1983	N/A	1996	34
1984	55.8	1997	18.7
1985	30.3	1998	33.5
1986	16.1	1999	42
1987	35.3	2000	47.8
1988	60.9	2001	56.3
1989	37.2	2002	32.8
1990	35.2	2003	48.9
1991	26	2004	35.5
1992	38.2	2005	37.3
1993	27.6	2006	51.2
1994	16.8	2007	27.9

6.5 Total Recruitment

The 0+ autumn trout will not be large enough to become sea trout smolts in the following spring. The remainder, predominantly 1+ years old, could contribute to the overall recruitment of sea-run trout the following year. The exact proportion of 1+ autumn trout that become smolts in any given year is not known.

It is only since 1982 that the proportion of 0+ trout amongst the autumn migration has been estimated. Thus the figures for total recruitment up to this time are over-estimated (Table 6.8).

From 1982, total recruitment was calculated by adding the number of sea trout smolts produced in any one year to the total of 1+ autumn trout the previous year (Table 6.9). The assumption is made that all the 1+ autumn trout will become sea trout smolts and that no 0+ trout from the two years previous will be recruited as smolts. The fate of 1+ unsilvered juveniles migrating downstream in January to May is unknown but it would seem unlikely that these will contribute to the 2 year old spring smolt migration.

Table 6.8. Estimates of total migrant trout recruitment up to 1981.

YEAR	SMOLT TOTAL	AUTUMN TROUT (preceding year)	TOTAL RECRUITMENT
1970-74	4450	2870	6746
1975-79	4314	3186	7489
1980	2337	2351	4688
1981	6710	2631	9341

Table 6.9. Estimates of total migrant trout recruitment from 1982.

YEAR	SMOLT TOTAL	AUTUMN TROUT 1+ & Older (preceding year)	TOTAL RECRUITMENT
1982	3907	1300*	5207*
1983	4852	1109	5961
1984	2383	1200*	3583*
1985	4238	611	4894
1986	3454	1472	4926
1987	3371	1726	5097
1988	4290	949	5239
1989	3179	556	3735
1990	2022	634*	2656*
1991	2137	636	2773
1992	1936	234	2170
1993	1720	183	1903
1994	1127	306	1433
1995	1821	282	2103
1996	1300	336	1636
1997	817	513	1330
1998	1608	717	2325
1999	1260	644	1904
2000	769	358	1127
2001	530	218	748
2002	1272	910	2100
2003	787	976	1763
2004	723	426	1149
2005	777	590	1367
2006	628	251	879
2007	593	377	970

* estimated

6.6 Marine Survival

An estimate of sea trout survival to first return to freshwater can be more accurately calculated by the use of trap census data rather than rod catch returns of tagged or marked fish. Small numbers of stray fish are captured in other systems and it is not known whether these fish would have returned to their natal systems to spawn. Finnock are known to wander between river systems and are therefore not as reliable for assessing survival.

The pattern of marine survival found is similar whether the number of smolts is used or the combined total recruitment of smolts and autumn 1+ trout. The percentage of smolts that return as finnock in the same year historically ranged from 11.4% to 32.4% (Fig. 6.3). In 1988 it fell below the previous recorded minimum to 8.5% and in 1989 to a minimum of 1.5%. There has been a saw-tooth pattern of finnock return in the 1990's rising to 16.7% in

1999 – the highest return rate since 1986. This increase was not, however, sustained in subsequent years and there was a collapse in 2005 down to 1.5%. This was associated with the heaviest infestations of sea lice observed in the Burrishoole area since 1992.

The total survival of smolts to the first return to freshwater as finnock in the same year and one year old sea trout in the following year (always an over-estimate as a proportion of finnock re-entering freshwater in year 1 return as sea trout in year 2 (Mills *et al*, 1990)) also shows a drop in survival from 1987 to 1989 (Fig. 6.4).

Historically, the total survival to first return ranged from 19% to 66%. This collapsed to 1.8% in 1989 but rose to 12.1% in 1990. However, little further improvement was recorded in 1991 (12.8%). Marine survival fell to the second lowest level in 1992 but returned to 13.1% for the 1993 year class of smolts. There was a further increase in 1994 to 18.2% but a drop in 1995 to 8.1%. There were marginal improvements again in 1996 (12.8%) and 1997 (13.3%), a drop to 8.3% in the 1998 year class and a marked improvement in the 1999 year class where marine survival was 20%, the highest recorded in 12 years and within the pre-collapse historical range.

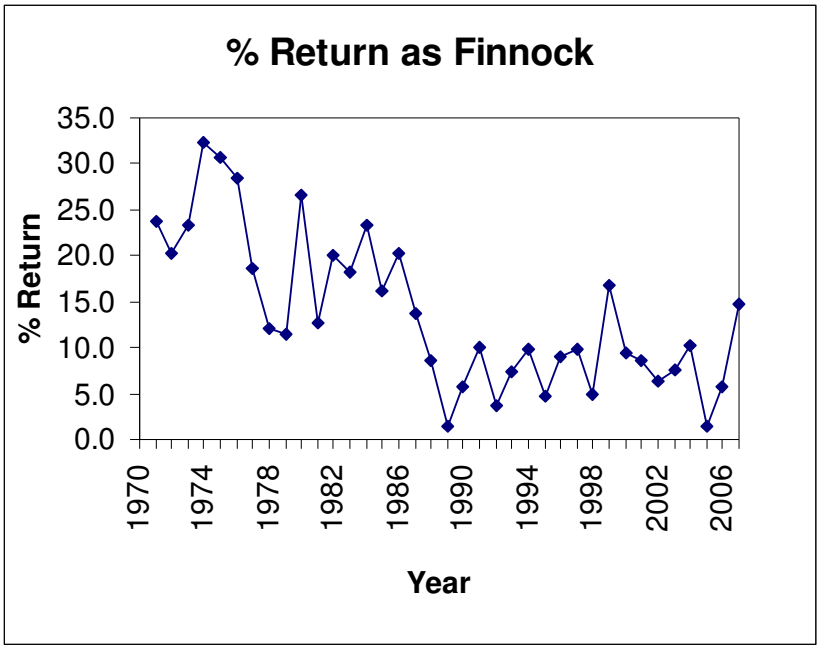


Fig. 6.3. Annual percentage return of smolts returning as finnock to the Burrishoole system.

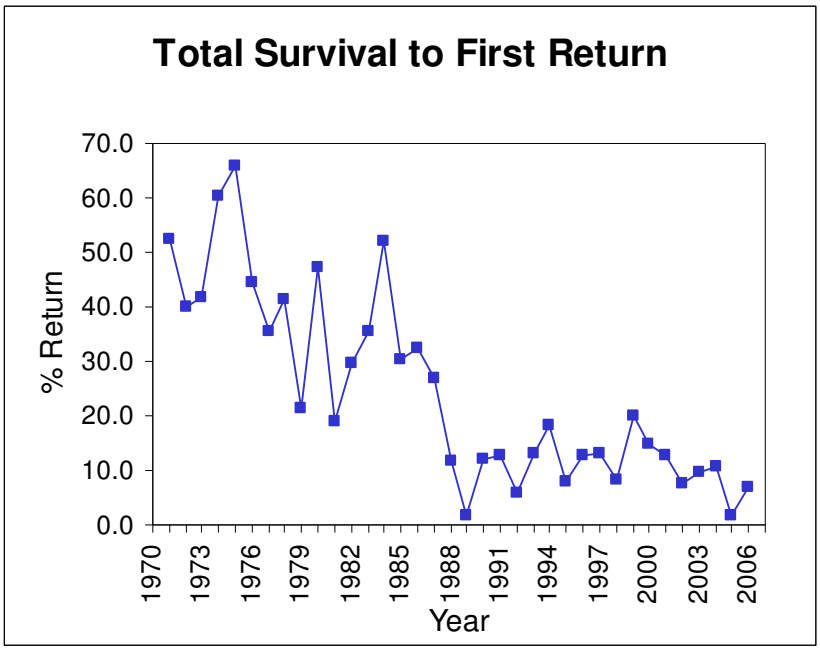


Fig. 6.4. Annual marine survival of smolts to first return (as finnock and 1+ sea trout) to the Burrishoole system.

6.7 Sea Trout Kelts

Table 6.10 gives the numbers of sea trout and brown trout kelts, both spawned and immature, counted downstream in the winter of 2006 and spring of 2007.

The freshwater survival of kelts is given in Table 6.11. In some years, the number of kelts migrating downstream has exceeded the number of upstream migrants. This occurred in the early '80s when the screen allowed finnock to escape. This was rectified. More recently, the difficulty in separating small finnock and large smolts has led once again to a discrepancy as shown in Table 15. In addition to the size overlap, trout counted upstream as unsilvered migrants may be counted downstream as silvered kelts, causing difficulties in making survival estimates.

Since 1987, only one survival rate has been given for all sizes as it has been shown that a proportion (at least 33%) of the sea trout population may over-winter in freshwater. These fish do not spawn and continue to grow. There is also the additional complication of larger smolts and reduced sea growth mentioned above. Thus the comparisons of the proportion of fish in different year classes between the upstream migrants of one year and the downstream migrants of the next are invalidated.

Table 6.10. Timing and numbers of sea trout kelts for the 2006/2007 season.

Month	Large ST	Small ST	BT	Total ST	Total Trout
October '06	0	7	5	7	12
November	3	18	12	21	33
December	4	30	62	34	96
January '07	2	3	22	5	27
February	1	6	6	7	13
March	4	5	34	9	43
April	1	3	8	4	12
May	0	0	2	0	2
June	0	0	2	0	2
Total	15	72	153	87	240

Table 6.11. Annual survival rate to sea trout kelt, as % of the upstream escapement of the previous year.

Year	Larger (> 30.0 cm)	Small (< 30.0 cm)
1976	79	66
1977	63	45
1978	50	66
1979	33	107*
1980	50	82
1981	44	345*
1982	53	203*
1983	63	177*
1984	74	210*
1985	70	98
1986	66	72
1987	58.7% (combined)	
1988	65.5%	"
1989	68.7%	"
1990	79.0%	" *
1991	98.7%	" *
1992	89.5%	" *
1993	96.7%	" *
1994	104.6%	" *
1995	96.2%	" *
1996	127.7%	" *
1997	97.0%	" *
1998	140.1%	" *
1999	110.4%	" *
2000	70.1%	"
2001	82.0%	" *
2002	129.6%	" *
2003	66.1%	"
2004	120.5%	"*
2005	142.2%	"*
2006	110.5%	"
2007	228.9%	"*

* Years when the number of finnock kelts counted downstream exceeded the number counted upstream during the previous season.

7 SILVER EEL CENSUS PROGRAMME

Silver eel trapping was continued in 2007. The main run occurred in September and November (Table 7.1). Figure 7.1 shows the daily counts of silver eels in relation to changes in water level. The main runs of eels were closely related to increases in level and heavily influenced by a drought in late August/early September.

The total run amounted to 2546 eels. As in other years, the highest proportion of the total catch (92%) was made in the Salmon Leap trap.

Table 7.1. Timing and numbers of the 2007 silver eel run.

	Salmon Leap	Mill Race	Total	%
June	5	1	6	0.2
July	25	4	29	1.1
August	93	5	98	3.8
September	930	72	1002	39.4
October	425	32	457	17.9
November	737	65	802	31.5
December	111	34	145	5.7
Jan. 2008	3	1	4	0.2
Feb	1	1	2	0.1
Mar	1	0	1	0.0
Total	2331	215	2546	

Sampling of individual eels (n = 571) gave an average length of 45.7 cm (range: 27.6 – 95.2 cm) and an average weight of 201 g (Table 7.2). The length frequency distribution is presented in Figure 7.2 along with those for 2005 and 2006 for comparison.

Catches of silver eel between the years 1971 (when records began) and 1982 averaged 4,400, fell to 2,200 between 1983 and 1989 and increased again to above 3,000 in the '90s (Fig. 7.3). There was an above average catch in 1995, possibly contributed to by the exceptionally warm summer. The catch in 2001 of 3875 eel was the second highest recorded since 1982. The average weight of the eels in the catches has been steadily increasing from 95 g in the early 1970s to 215 g in the 1990s (Fig. 7.3).

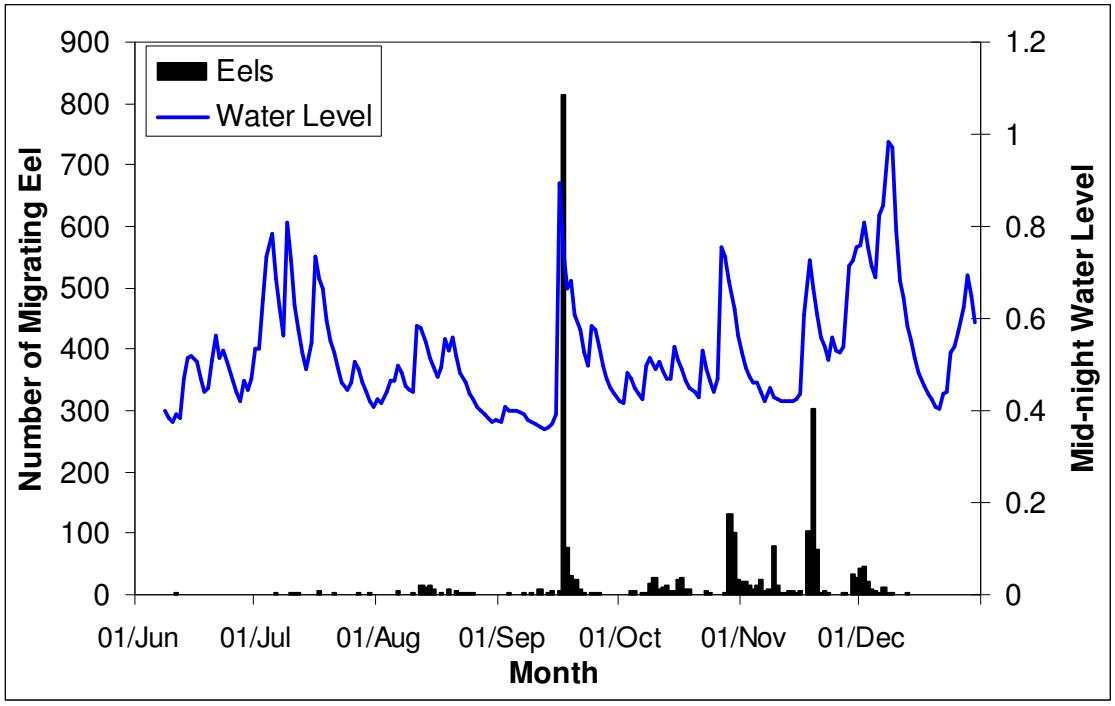


Fig. 7.1. Daily counts of downstream migrating silver eel and mid-night water levels.

Table 7.2. Comparative data for the silver eel runs since 1971

Years	Number Sampled	Mean. Weight (gm)
1971 - '75	4465	84
1976 - '80	4023	115
1981 - '85	2678	171
1986 - '90	11658	196
1986	1856	194
1987	2713	195
1988	3283	206
1989 *	685	254
1990	3121	176
1991	266	246
1992	523	186
1993	181	260
1994	468	220
1995	2003	225
1996	1172	184
1997	1022	238
1998	845	208
1999	577	220
2000	342	212
2001	850	238
2002	732	207
2003	650	177
2004	382	216
2005	587	237
2006	493	225
2007	571	201

* Incomplete due to flood damage

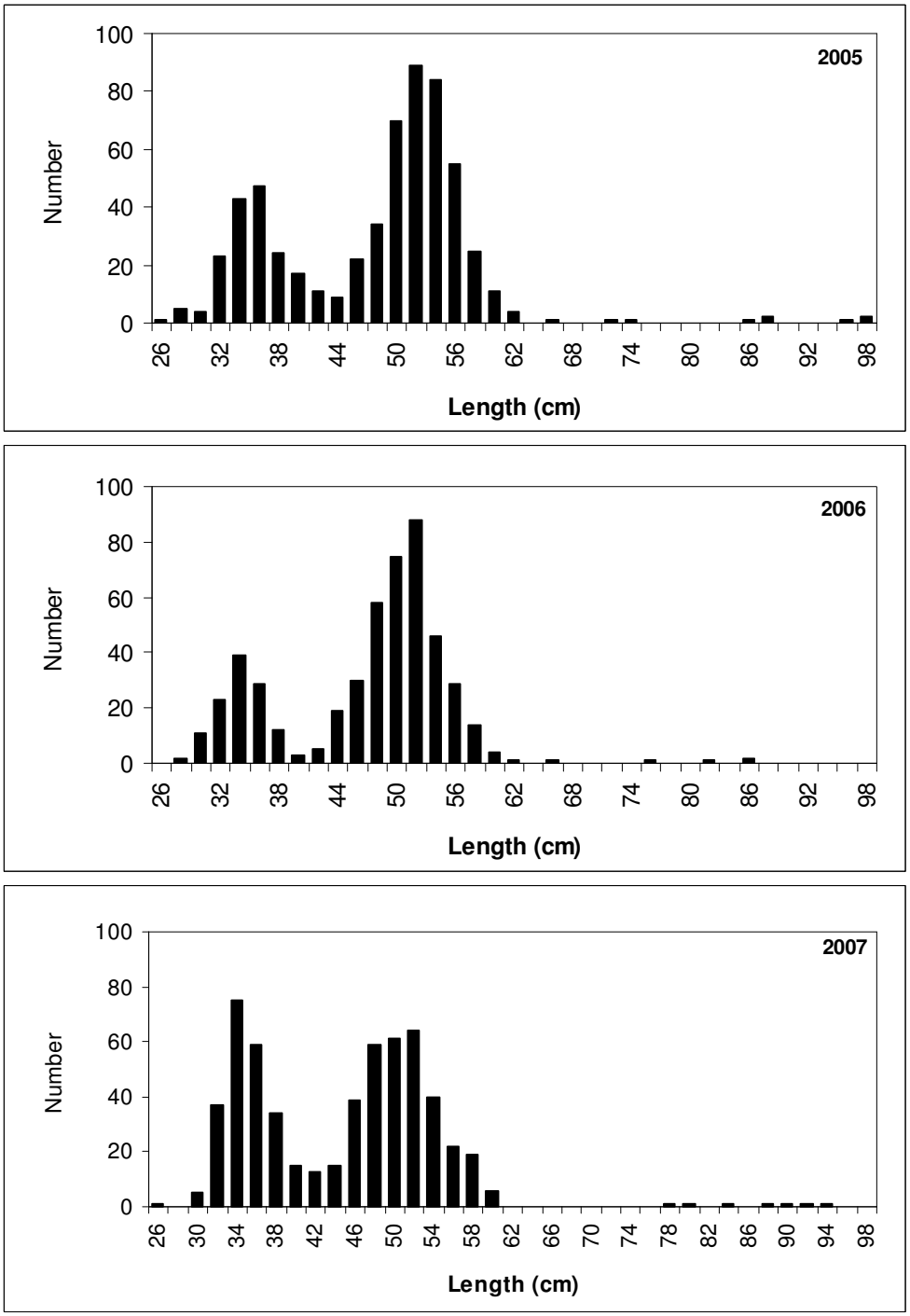


Fig. 7.2. Length frequency of silver eels trapped in the downstream traps, 2005 (n=587), 2006 (n=493) and 2007 (n=571).

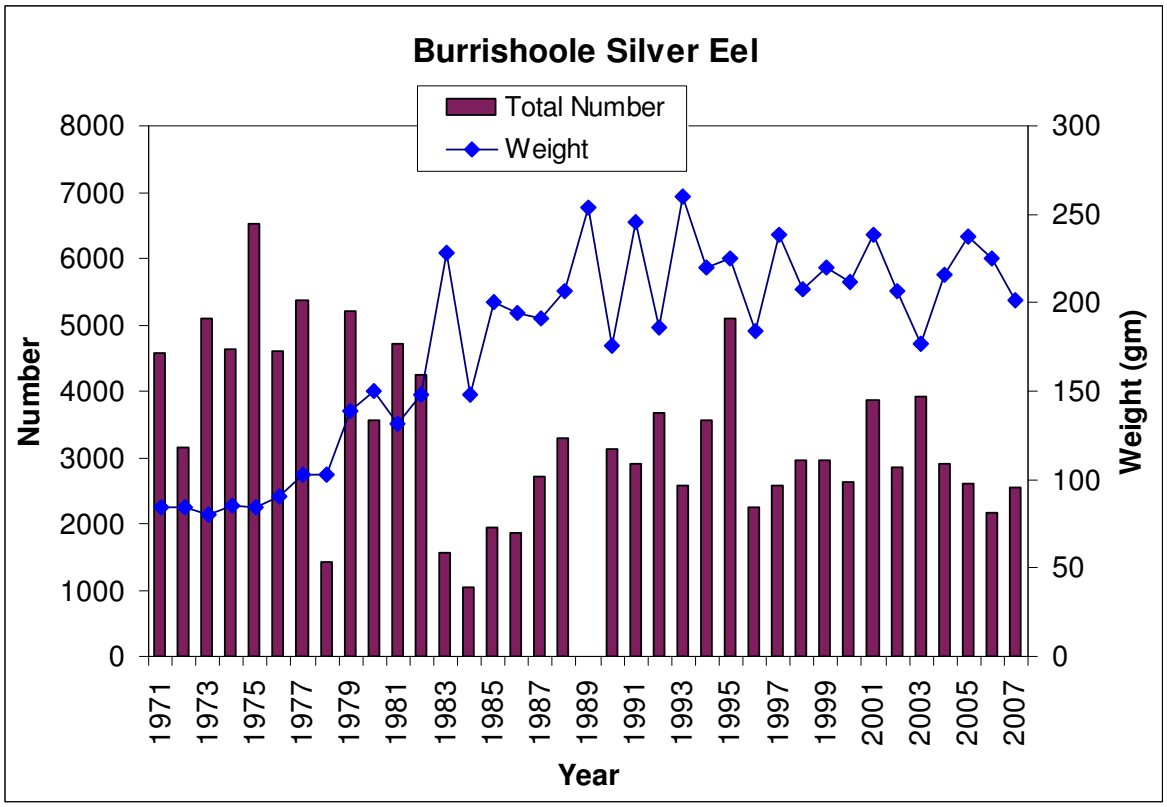


Fig. 7.3. Annual number and mean weight of silver eels trapped in the downstream traps.

8 FISHERY REPORT - CATCH DATA

8.1 Numbers and Average weight of Rod Catch

A total of 195 salmon were caught in the Burrishoole Fishery in 2007. The catch consisted of 169 reared fish and 26 wild fish. For conservation purposes 24 of the wild fish were returned alive.

The average weight of reared fish was 1.7 kg (n=164); the heaviest reared fish 3.3 kg. There was a high percentage (67%) of small fish in the catch in 2007 with a total of 113 fish weighing less that 2kg. No lengths or weights are available for wild fish.

The total trout rod catch was 58 fish. Regulations remained in place whereby all rod caught sea trout were returned alive.

8.2 Timing of Catch and Rod Effort

Angling was again confined to Lough Furnace during 2007 as Lough Feeagh remained closed as a conservation measure.

The good return rate of both wild and reared fish, partly as a consequence of the drift netting ban introduced in 2007 and the wet summer resulted in the rod effort increasing from 2065 hrs in 2006 to 3216 hrs in 2007. As in 2006, the run of fish was later than observed in previous years and consequently the rod effort in September was 605 hrs compared to 252 hrs the previous year.

Table 8.1. Wild and reared salmon rod catch and rod effort (hours) for the 2007 season.

	Salmon Catch		Effort in hours
	Wild	Reared	
May	0	0	0
June	1	1	219
July	13	88	1337
August	10	60	1055
September	2	20	605
Total	26	169	3216

The overall salmon catch has continued to increase in recent years. It increased from 55 in 2005 to 114 in 2006 and 195 in 2007. Whereas the overall salmon catch increased, the wild catch in 2007 decreased from 48 fish to 26. The overall survival of wild grilse at 13.6% was one of the highest in recent years and the lower rod catch was likely as a result of the wet summer which enabled fish to run directly into Lough Feeagh. The reared catch increased from 66 fish in 2006 to 169 in 2007.

8.3 Exploitation Rates of Rod Fishery

Rod exploitation rates for Lough Furnace and Lough Feeagh from 1990 to 1996 are shown in Table 34. From 1997 onwards Lough Feeagh was closed to angling. Exploitation rates are only available for Lough Furnace for these years. The cessation of angling on Lough Feeagh was due to the continuing low stock level of wild fish. Anglers fishing on Lough Furnace were requested to return wild fish alive to the water. Injured wild fish were permitted to be retained; therefore the rod catch on Lough Furnace consists of a total catch which includes released fish and a retained catch which are fish that have been killed.

Table 8.2. Rod Fishing Exploitation Rates (2001-2007) – revised fish counts are used for 2006 & 2007.

	2000	2001	2002	2003	2004	2005	2006	2007
WILD SALMON								
Lough Feeagh								
"Available" fish by end of fishing season	*	*	*	*	*	*	*	*
Total rod catch								
Rod catch retained								
Angling success %[1]								
Exploitation rate %[2]								

WILD SALMON	2000	2001	2002	2003	2004	2005	2006	2007
Loughs Feeagh & Furnace								
Total stock of wild fish	580	375	651	565	610	542	566	1063
+ 10% addition for L. Furnace population	638	413	716	622	671	596	623	1169
Total catch of wild fish	70	17	12	373	10	27	48	26
Rod catch retained	6	1	1	2		1	5	2
Max. angling success %	12.1	4.5	1.8	6.5	1.6	5.0	8.5	2.4
Min. exploitation rate	0.9	0.2	0.14	0.5	0.3	0.2	0.9	0.2
Max. exploitation rate	1.0	0.3	0.15	0.5	0.3	0.2	0.8	0.2

REARED SALMON	2000	2001	2002	2003	2004	2005	2006	2007
Lough Feeagh								
"Available" fish by end of fishing season	*	*	*	*	*	*	*	*
Total rod catch								
Rod catch retained								
Angling success %[1]								
Exploitation rate %[2]								
Loughs Feeagh & Furnace								
Total stock	1257	834	860	1178	902	952	954	2624
Total rod catch	129	43	10	22	64	28	66	169
Exploitation rate %	10.3	5.2	1.2	1.9	7.1	2.9	6.9	6.4

WILD SEA TROUT	2000	2001	2002	2003	2004	2005	2006	2007
Lough Feeagh								
"Available" fish by end of fishing season	*	*	*	*	*	*	*	*
Rod catch								
Exploitation rate %								

* No Fishing on Feeagh

8.4 Angling Success

Table 8.3. Catch per unit effort (CPUE) and effort per unit catch (EPUC) for the Burrishoole Fishery

	Lough Furnace				Lough Feeagh			
	Salmon		Sea Trout		Salmon		Sea Trout	
Year	CPUE	EPUC	CPUE	EPUC	CPUE	EPUC	CPUE	EPUC
'80-'84	0.13	9.92	0.85	1.35	0.23	4.47	0.63	2.1
'85-'89	0.24	4.89	0.46	5.09	0.24	4.57	0.29	70.3
'90-'95	0.2	6.1	0.17	16.8	0.2	5.4	0.1	14
'96	0.22	4.4	0.1	10.5	0.83	1.2	0.3	2.9
'97	0.17	6	0.1	9.6	*	*	*	*
'98	0.44	2.3	0.08	13.2	*	*	*	*
'99	0.09	10.8	0.05	20.8	*	*	*	*
'00	0.3	3.31	0.06	16.5	*	*	*	*
‘01	0.15	6.7	0.12	8.4	*	*	*	*
’02	0.12	8.3	0.07	15.3	*	*	*	*
’03	0.13	7.6	0.06	17.7	*	*	*	*
’04	0.22	4.6	0.16	6.3	*	*	*	*
’05	0.26	3.8	0.08	13	*	*	*	*
’06	0.44	2.3	0.04	23.5	*	*	*	*
’07	0.49	2.1	0.14	6.9	*	*	*	*

* Closed to angling

Annex 1: Macro-invertebrate Survey of rivers in the Burrishoole and Owengarve catchments, 2006 and 2007.

Introduction

The fourth and fifth annual reports (data collected in 2006 and 2007) on the macroinvertebrate biological monitoring of the Burrishoole catchment are presented here together. This program started in 2003 and we have now collected 5 years continuous data. The research facility in Furnace is ideally placed for the collection and analysis of data applicable to the long term monitoring of lotic and lentic freshwater habitats. In 2003, a formal, consistent monitoring plan was implemented, which should be continued long term to enable annual trends in water quality to be captured.

The main land uses in the Burrishoole catchment are forestry and agriculture. The agriculture is mainly hillside subsistence farming, with large numbers of mountain sheep. About 18% of the Burrishoole catchment and 7% of the Owengarve catchment is under active coniferous forestry plantations, which were planted in batches starting in the 1970's. The base geology on the west side of the Burrishoole catchment (Glenamong, Altahoney and Maumaratta subcatchments) is predominantly quartzite/schist, making them acidic in nature, with poor buffering capacity. On the east side of the catchment (Rough, Lodge, Goulaun and Cottage subcatchments), the geology is much more complex and while there is also quartzite/schist, it is interspersed with veins of volcanic rock, dolomite, wacke and pure schist, which means that the buffering capacity is higher as is the aquatic production. The Owengarve catchment is split in half with quartzite/schist in the northern half, and sandstone in the southern half (Fig. 1).

Methods

Macroinvertebrate samples were sampled in May 2006 and 2007 from two sites in each of the main Burrishoole subcatchments, and two sites in the Owengarve catchment (Fig. 2). Three replicate 1ft sq surber samples were taken from riffle / stony areas. Samples were stored in >70% IMS and sorted and identified using standard keys in the laboratory. Data was collated at both taxa and order level and was combined with data from 2003, 2004 and 2005. Biotic indices (ASPT, BMWP, Q index, No. of taxa, No. of EPT taxa, acidity index) were also calculated for each site.

Results and discussion

A total of 1187 individual macroinvertebrates, representing 38 taxa, were sorted and identified from the 2006 samples. This is the lowest number of taxa found since the program started in 2003 (Table 1). The average number of animals per sample ranged from 8 ± 4 (s.d) at the Cottage top site to 69 ± 57 at the top of the Goulaun (Fig. 3). Highest numbers of taxa were sampled from the Goulaun and Lodge rivers (Fig. 4). 1024 individuals from 44 taxa were sorted and identified from the 2007 samples. The average number of individuals ranged from 6 ± 2 (s.d) at the bottom of the Altahoney to 58 ± 13 (s.d) at the top of the Goulaun (Fig. 3). The Goulaun and Lodge rivers again had the most taxa (Fig. 4). As in previous years, the macroinvertebrates on the Burrishoole and Owengarve catchments in 2006 and 2007 were dominated by Ephemeroptera, Diptera, Plecoptera, Coleoptera and Trichoptera (Fig. 5).

The use of biotic indices helps to condense all the taxa and assemblage information into single values, and indices were calculated for the five years data to date (2003-2005). Several of these indices are specifically designed to monitor nutrient enrichment (Q index, ASPT,

BMWP) (Hawkes, 1997; McGarrigle *et al.*, 2002) while the acidity index is used to monitor acidification (Henrikson and Medin, 1986). The Shannon diversity index gives a overall view of the diversity at each site (Fig. 6), and ranged between 1.8 and 2.8 in 2006 and 1.9 and 2.7 in 2007 within our sampling sites. The number of EPT taxa (Ephemeroptera, Plecoptera and Trichoptera), which are indicative of high water quality, ranged from 3 to 13 in 2006 and 2 to 10 in 2007 (Fig. 7). In both years, the numbers of EPT taxa were highest in the Goulaun and Lodge rivers. The BMWP (Biological Monitoring Working Party) score ranged from 46 to 110 in 2006 and 45 to 115 in 2007 (Fig. 8). A BMWP score of greater than 100 are associated with clean rivers, while heavily polluted rivers would score less than 10, so the BMWP scores for our sampling sites suggest that our rivers are not been impacted by nutrient enrichment. The ASPT scores (which are calculated by dividing the BMWP score by the number of taxa, to standardise for sample size) ranged from 6.4 to 8 in 2006 and 6.1 to 7.8 in 2007 (Fig. 9), which was an improvement on 2005. The BMWP, ASPT and Q index (rivers were either 3, ¾ or 4 – Fig. 10)) generally do not tell us much about our rivers, except to show that nutrient enrichment is not really an issue at the moment in these rivers.

A more insightful index is the acidity index, which is calculated using several metrics related to acid sensitive species, and general macroinvertebrate diversity. The acidity index ranged from 1 to 8 in 2006 and 1 to 11 in 2007 (Fig. 11) and the index is consistent within sites sampled across the five years. This indicates that this index is quite robust. The Altahoney and Maumaratta have the lowest values in all years, indicating that the macroinvertebrates assemblages in these rivers are a very good reflection of the acid nature of the water. The acidity index ranges from 0-14, and the Swedish EPA recommends that a river that is unaffected by acidity (in reference conditions) would have an acidity score of at least 6. Some of the rivers in the Burrishoole and Owengarve catchments are well below this, and while it is largely a reflection of the underlying geology, it seems likely that the very low scores (1-3) are a reflection of the impact of forestation.

As this report is the culmination of five years data, it is worth considering a number of points. Firstly, 2004 seems to be somewhat of an outlier with regard to taxa richness and number of individuals recorded. This may be as a result of operator differences (E. de E on leave in 2004 at time of sampling), or it may be that 2004 was an exceptionally productive year in rivers. Analysis of temperature differences across the time period 2003-2007 may prove insightful. Another point to highlight is the apparent decrease in water quality in the Rough river in 2006 and 2007, as evidenced by the decrease in the number of EPT taxa (Fig. 7), the acidity index (Fig. 11) and the general number of taxa (Fig. 4), all of which are lower than in previous years. The acidity index is sensitive to the absence of amphipods, which accounts for some of the decrease. Species which had lower abundances in 2006 and 2007 included *Baetis rhodani, Rhithrogenia semicolorata, Ephemerella ignita* and *Leuctra hippopus* (Fig. 12). *Baetis rhodani* is a relatively tolerant mayfly species, but the drop in numbers of the other three species which are considered sensitive to disturbance is worrying, and requires further attention in 2008.

Acknowledgements

Thanks to Elizabeth Ryder, Katie Thomas, Gearoid Kirwan, Michael O'Sullivan, Sean Gallanagh, Saranne O'Malley and Anthony Singleton for sorting and identifying samples, and helping with sampling.

References

Hawkes HA. 1997. Origin and development of the Biological Monitoring Working Party Score System. *Water Research* **32**: 964-968.

Henrikson L, Medin M. 1986. *Biologisk bedömning av försurningspåverkan på Lelångens tillflöden och grundområden, 1986*. Älvsborgs. Aquaekologerna: Report to County Administrative Board.

McGarrigle ML*, et al.* 2002. *Water quality in Ireland.* Wexford. EPA.

Table 1. Macroinvertebrate taxa sampled from the Burrishoole and Owengarve catchments, 2003-2007

Order	Taxa	2003	2004	2005	2006	2007
Total taxa		**61**	**83**	**62**	**38**	**44**
Acari	Hydracarina	x	x	x		x
Amphipoda	Gammarus duebenii	x	x	x	x	x
Coleoptera	Coleoptera			x		
	Dryopidae		x			x
	Dytiscidae	x	x			x
	Elmis aenea	x	x	x	x	x
	Esolus parallelepipedus	x	x	x		x
	Gyrinidae		x			
	Helodidae	x	x	x	x	x
	Hydraenidae	x		x		
	Hydroporinae		x	x	x	x
	Hygrobiidae		x			
	Limnius volckmari	x	x	x	x	x
	Oulimnius tuberculatus	x	x	x		x
	Stenelmis canaliculata		x			
Collembola	Collembola	x	x			
Diptera	Chironomidae	x	x	x		x
	Chironominea	x	x	x	x	x
	Culicidae	x	x	x	x	
	Dicranota	x	x	x	x	x
	Diptera	x		x		
	Muscidae				x	
	Orthocladinae	x	x	x	x	x
	Ptychopteridae		x			
	Simulidae	x	x	x	x	x
	Tabanidae		x	x		
	Tanypodinae	x	x	x	x	x
Ephemeroptera	Baetis atrebatinus	x				x
	Baetis rhodani	x	x	x	x	x
	Baetis sp.					x
	Caenidae			x		
	Caenis macrura	x				
	Caenis rivulorum	x	x		x	x
	Caenis horaria		x			
	Centrophilum luteolum		x	x		
	Ecdyonurus	x				
	Ecdyonurus insignis	x	x			
	Ecdyonurus dispar		x	x		
	Ecdyonurus torrentis			x		
	Ecdyonurus venosus	x	x	x	x	x
	Ephemerella ignita	x	x	x	x	x
	Ephemerella notata		x	x		
	Ephemeroptera			x		
	Heptagenia			x	x	x
	Heptagenia lateralis	x	x	x		
	Heptagenia sulphurea		x			

Table 1. (Cont.)

Order	Taxa	2003	2004	2005	2006	2007
Ephemeroptera	Heptagenia fuscogrisea					
	Heptagenidae		x			
	Leptophlebia	x	x			
	Rhithrogena germanica			x		
	Rhithrogena semicolorata	x	x	x	x	x
Hemiptera	Veliidae		x			
Hirudinea	Hirudinea		x			
Mollusca	Ancylus fluviatilis	x		x		
	Hydrobia ulvae	x				
	Hydrobiidae			x		
	Pisidium			x	x	
	Potamopyrgus jenkinsi	x	x		x	x
Odonata	Anisoptera			x		
Oligochaete	Oligochaete	x	x	x	x	x
Ostracoda	Ostracoda		x			
Platyhelminthes	Platyhelminthes	x				
Plecoptera	Amphinemura sulciollis	x	x	x	x	x
	Chloroperla torrentium	x	x	x	x	x
	Diura bicaudata	x				
	Isoperla grammatica	x	x	x	x	x
	Leuctra hippopus	x	x	x	x	x
	Leuctra inermis	x	x			
	Leuctra fusca		x	x		
	Nemoura cinerea		x		x	x
	Perla bipunctata		x			
	Perlodes microcephala		x			
	Perlodidae		x			
	Plecoptera			x		
	Protonemura meyeri					
Trichoptera	Agrypnia obsoleta					
	Athripsodes		x			
	Beraeidae	x				
	Cheumatopysche lepida		x			
	Cyrnus trimaculatus	x				
	Diplectrona felix	x	x			
	Ecnomus tenellus		x			
	Economidae	x		x		
	Glossosoma	x	x			
	Glossosoma boltani	x				
	Glossosomatidae		x	x		
	Holocentropus					
	Holocentropus dubius	x	x	x	x	
	Hydropsyche contubernalis	x	x			
	Hydropsyche siltalai	x	x	x	x	x
	Hydropsychidae			x		
	Hydroptila	x	x	x	x	x

Table 1. (Cont.)

Order	Taxa	2003	2004	2005	2006	2007
Trichoptera	Lepidostomatidae		x		x	x
	Limnephilidae		x	x		
	Lype phaeopa	x	x			x
	Metalype fragilis	x	x	x	x	
	Odontocerum albicorne		x			
	Philopotamidae			x		
	Philopotamus montanus	x	x			
	Phryganea			x		
	Phryganeidae			x		
	Plectrocnemia	x	x			
	Plectrocnemia conspersa				x	x
	Polycentropidae		x	x		
	Polycentropus flavomaculatus	x	x	x	x	x
	Polycentropus kingi	x	x			
	Polycentropus irroratus		x			
	Psychomyia pusilla	x	x	x	x	x
	Psychomyidae	x	x	x		
	Rhyacophila dorsalis	x	x	x	x	x
	Rhyacophila munda		x			
	Rhyacophilidae			x		
	Sericostomatidae		x			x
	Silo pallipes	x	x	x	x	x
	Tinodes dives		x			
	Tinodes muculicornis		x			x
	Tinodes waeneri		x		x	x
	Trichoptera	x	x	x	x	x

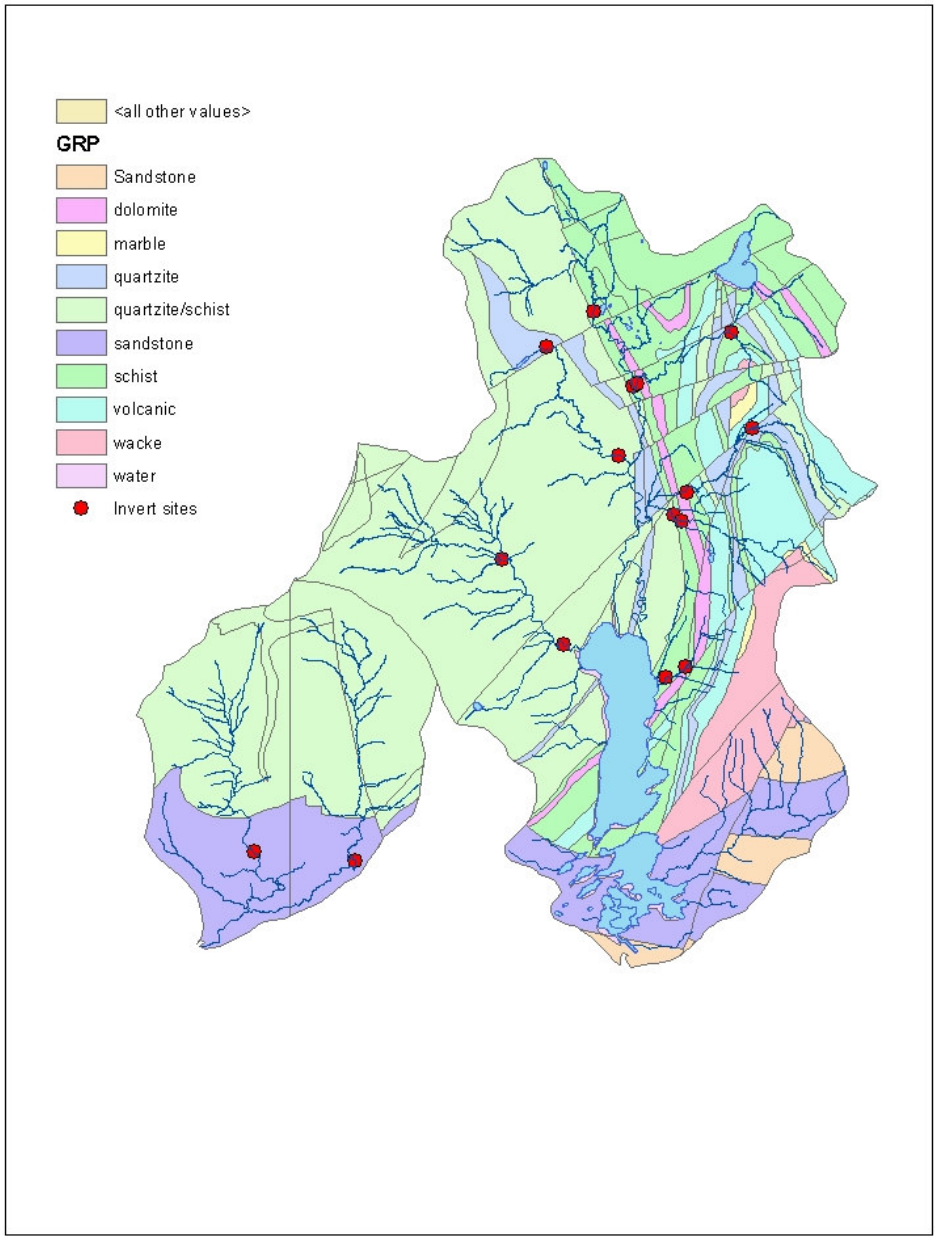


Fig. 1. Geology of the Burrishoole and Owengarve catchments, and position of macroinvertebrate sampling sites.

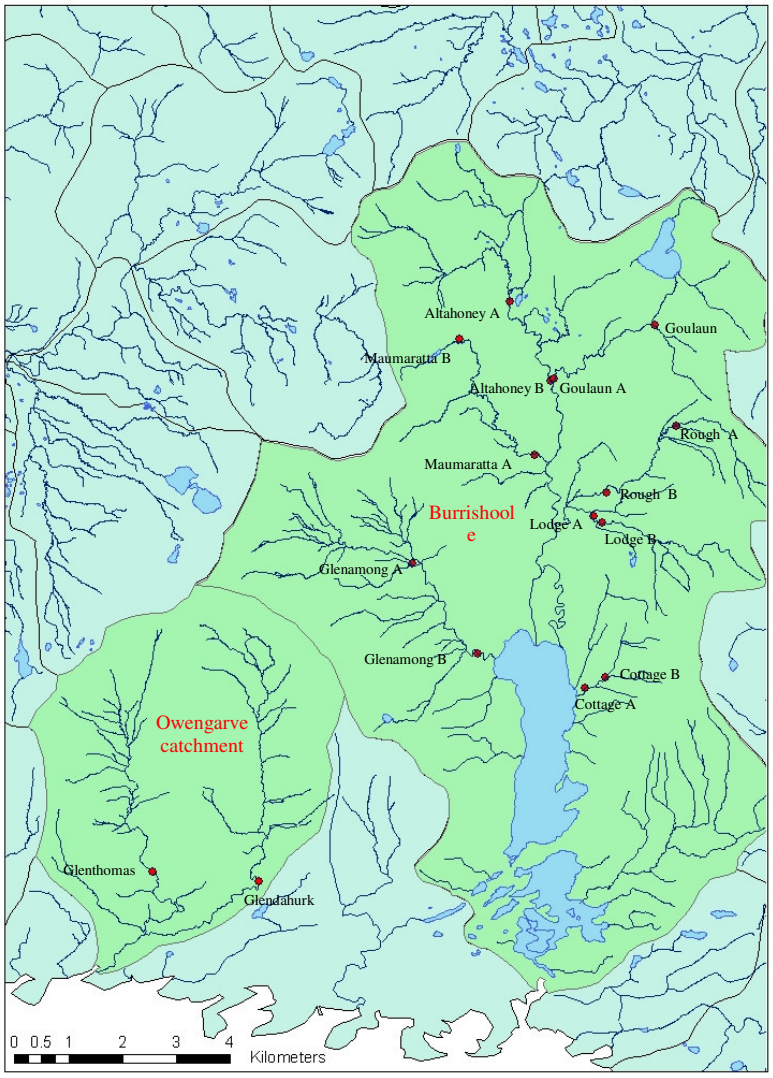


Fig 2. Macroinvertebrate sampling sites in the Burrishoole and Owengarve catchments included in the biological monitoring programs 2003-2007.

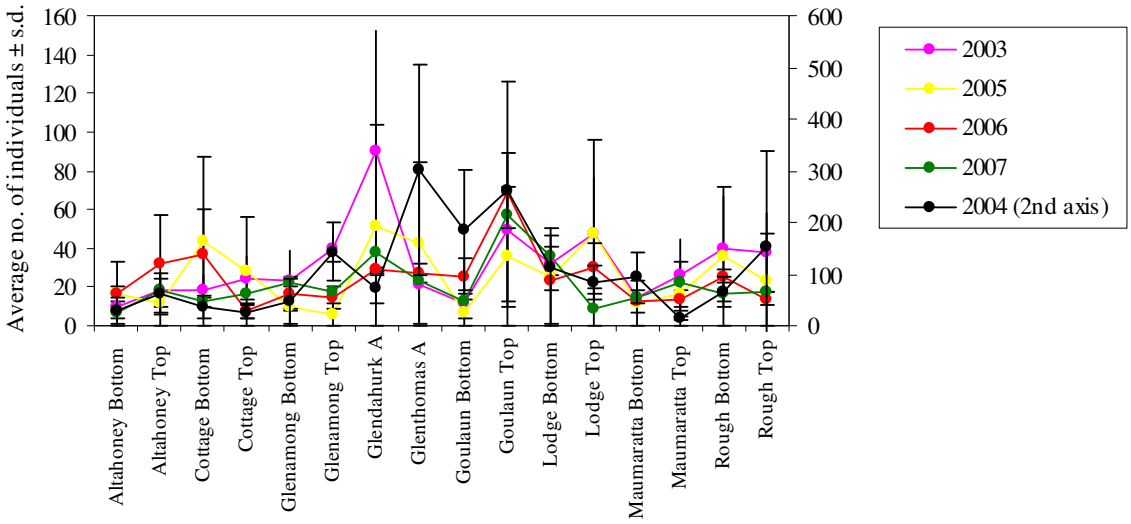


Fig. 3. Average number ± s.d. of macroinvertebrates found in a 1ft sq surber sample in the Burrishoole and Owengarve catchments 2003-2007. N.b. 2004 values are on the secondary axis.

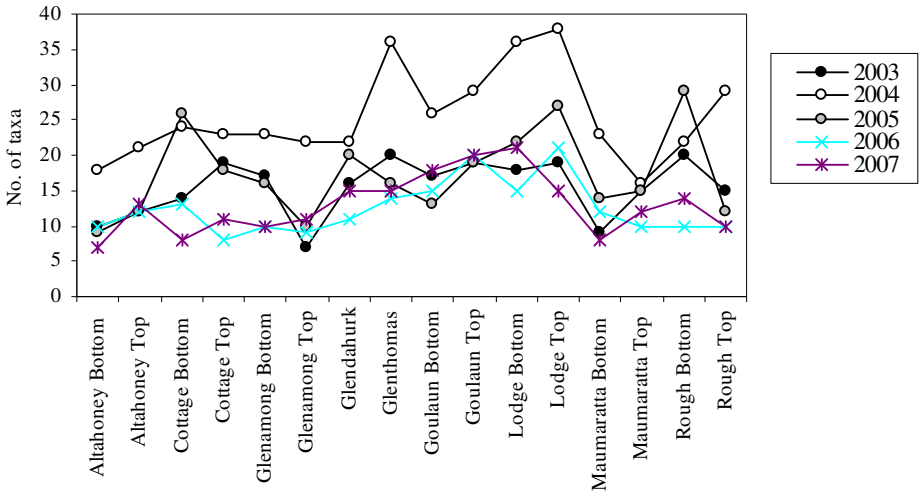


Fig. 4. Number of macroinvertebrate taxa found in 1ft sq surber samples in the Burrishoole and Owengarve catchments 2003-2007.

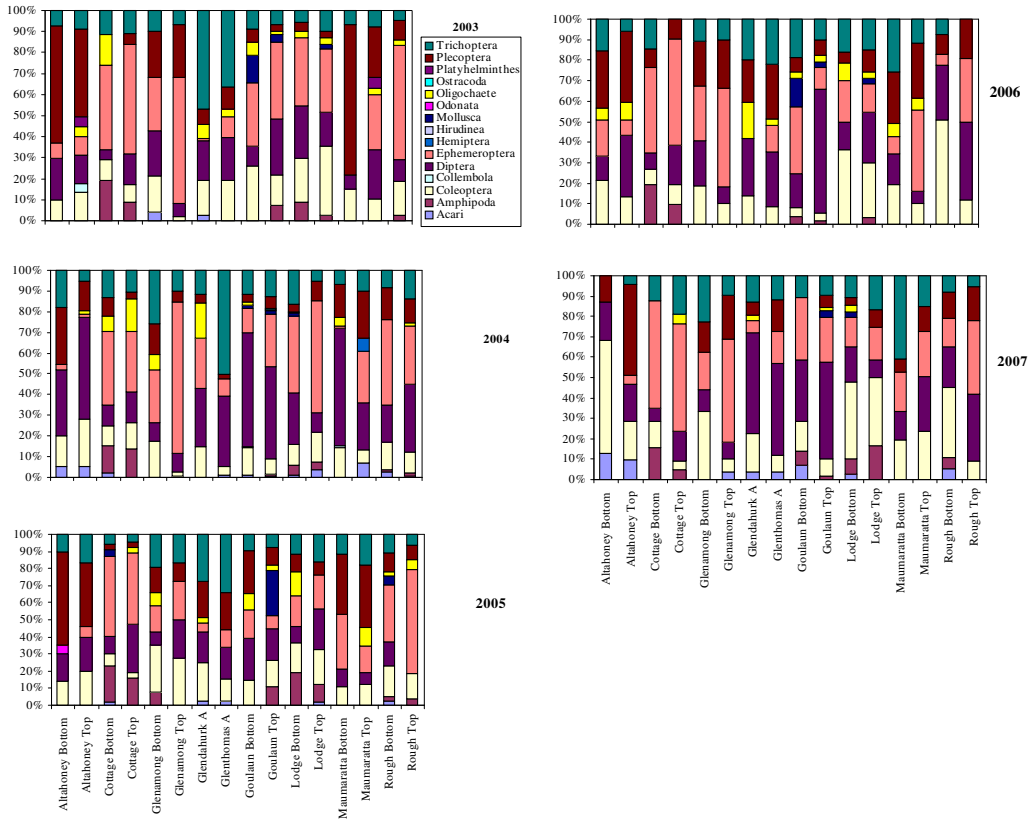


Fig. 5. Proportional abundances of the most common orders of macroinvertebrates found in the Burrishoole and Owengarve catchments, sampled between 2003 and 2007

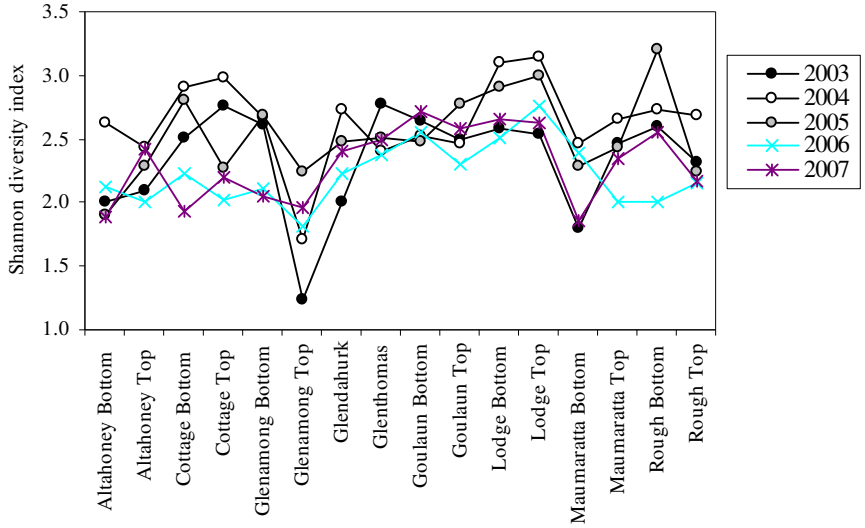


Fig. 6. Shannon diversity index calculated for macroinvertebrates sampled from the Burrishoole and Owengarve catchments 2003-2007.

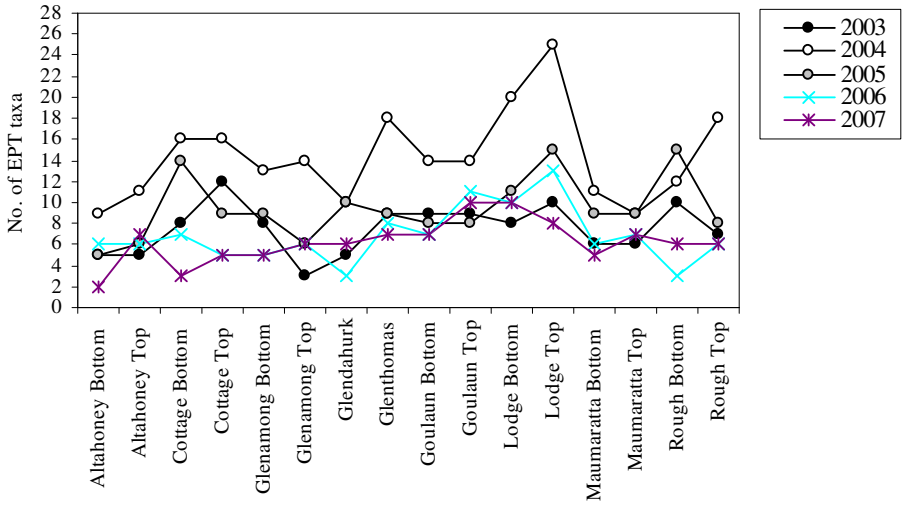


Fig. 7. Number of EPT (Ephemeroptera, Plecoptera, Trichoptera) taxa calculated for macroinvertebrates sampled from the Burrishoole and Owengarve catchments 2003-2007.

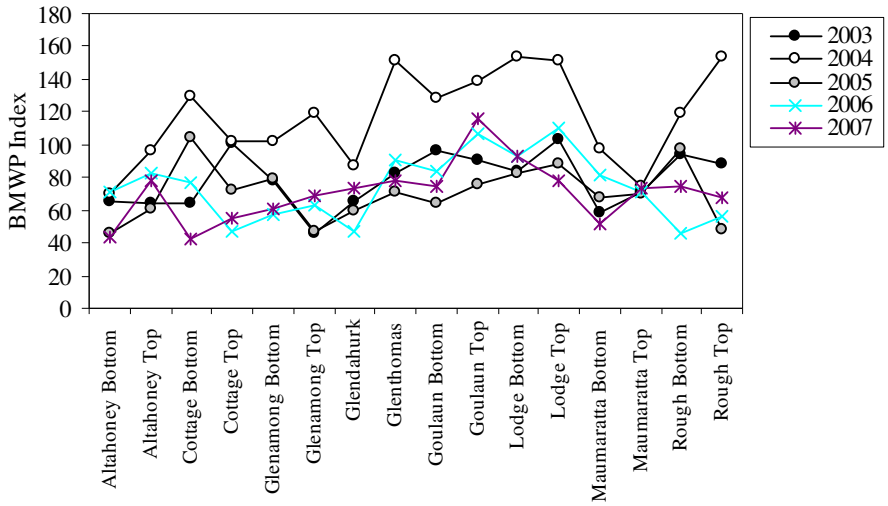


Fig. 8. BMWP calculated for macroinvertebrates sampled from the Burrishoole and Owengarve catchments 2003-2007.

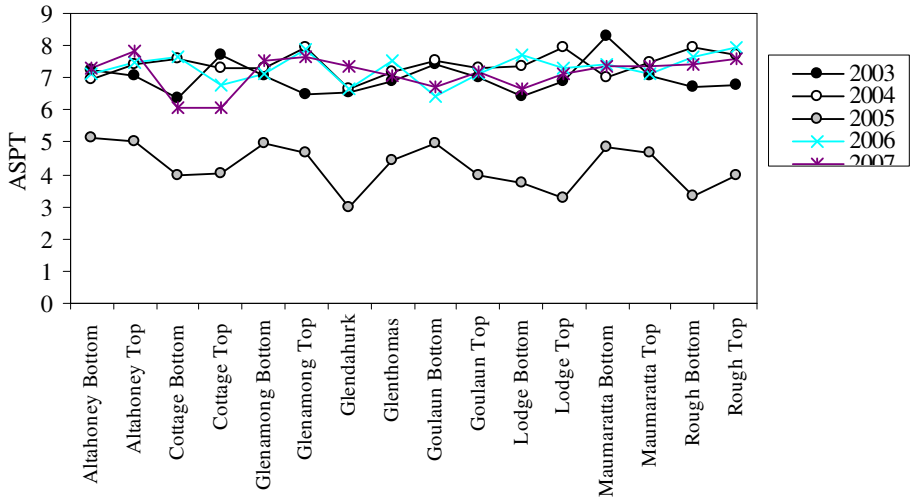


Fig. 9. ASPT calculated for macroinvertebrates sampled from the Burrishoole and Owengarve catchments 2003-2005

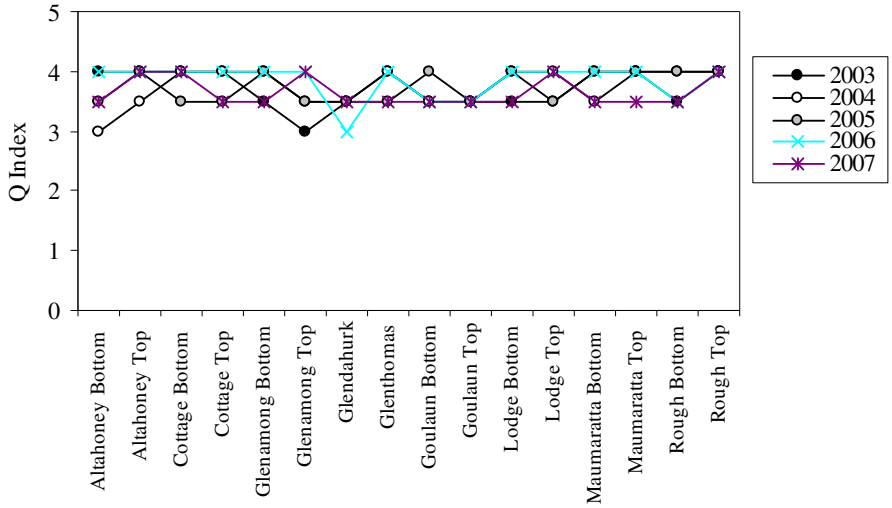


Fig. 10. Q index calculated for macroinvertebrates sampled from the Burrishoole and Owengarve catchments 2003-2005.

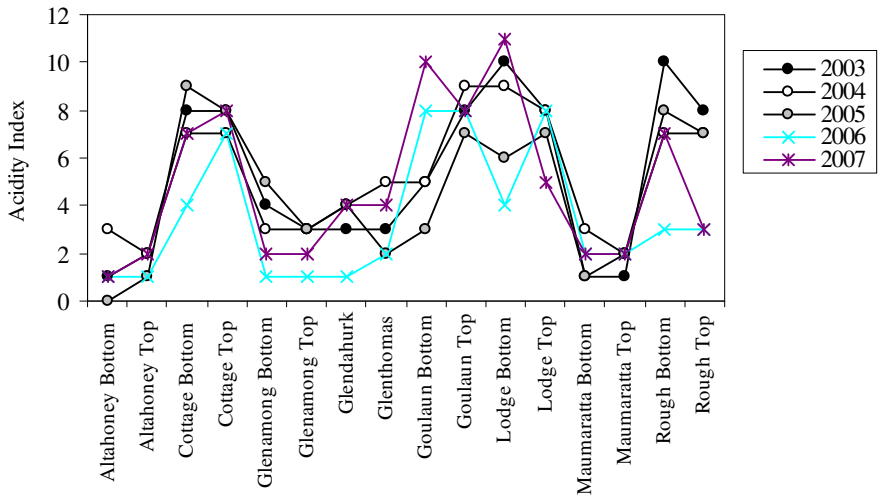


Fig. 11. SI acidity index calculated for macroinvertebrates sampled from the Burrishoole and Owengarve catchments 2003-2005.

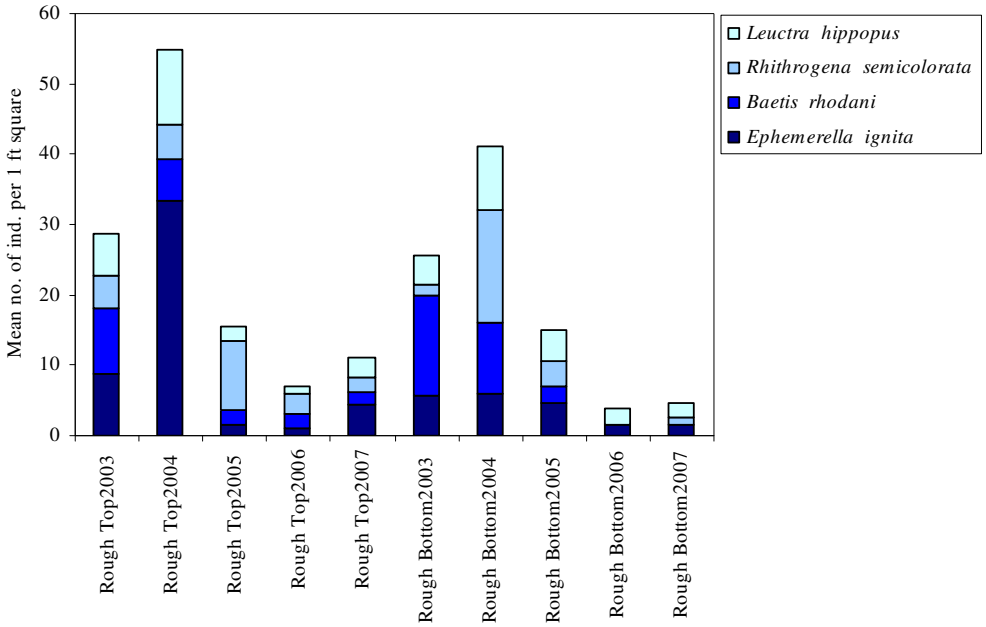
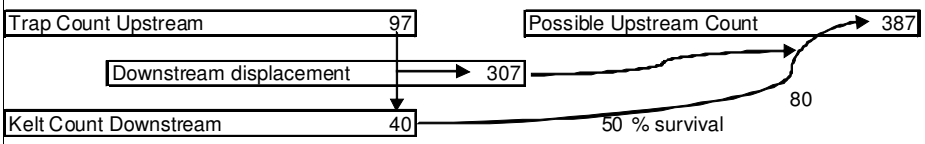


Fig. 12. No. of individuals of some taxa from the Rough River sampled 2003-2007. Numbers are averages of three replicate surber samples.

Annex 2: Revised figures for upstream trap counts, 2007.

Reared Return **2007**



therefore: 97 is 25.1% of estimated upstream run.

Wild Grilse Return

Assuming the problem was in the Mill Race Trap/fence

1. Estimate Based on Equivalent escape compared to reared fish

188 WG in MR & 795 in the SL = 983 2008 Kelt count = 492

188 raised by RG estimated % = 750 estimated WG MR count

750 WG in MR & 795 in the SL = 1545 less lost 96 = 1449 Sp. Stck

Kelt survival of Sp. Stck = 34.0% Too Low?

2. Worst Case Scenario Based on Whole Run raised similar to reared fish

188 WG in MR & 795 in the SL = 983

983 raised by RG estimated % = 3922 estimated WG MR count

Therefore the Total estimated WG count = 3922 less lost 96 = 3826 Sp. Stck

Kelt survival of Sp. Stck = 12.9% Too Low?

3. Scenario based on Average survival to Kelt

Average survival to kelt = 51.1% for 2001-2005

therefore: 492 = Sp. Stck of : 963 plus 86 = run of 1049 ex. spring fish

4. Scenario based on smolt return to trap

2006 Smolt Count = 7701

Upstream Count = 983 plus 2 Furnace rod = return 985

Actual Count	Percent Return	12.8%	5.4% diff from average	No drift nets
Scenario 1	Percent Return	20.1%	12.7%	
Scenario 2	Percent Return	51.0%	43.6%	
Scenario 3	Percent Return	13.6%	6.2%	

Average 5 year return for smolt = 7.4% for 2001-2005